1 GENERAL DESCRIPTION

1.1 Performance parameter table

1. Main dimensions

Item		LZ970-1, LZ970-2, LZ970-3
Overall length		4320,4260,3998(mm)/170,168,157(in)
Overall width		1528,1475,1475(mm)/60,58,58(in)
Overall height		1845,1890,1890(mm)/73,74,74(in)
Wheelbase		2600,2550,2550(mm)/102,100,100(in)
Truck	Front	2010,2970,2708(mm)/79,117,107(in)
	Rear	1310,1290,1290(mm)/516,508,508(in)

2. Mass parameter

Item		LZ970-1	LZ970-2	LZ970-3
kurb mass(lbs)		1807	1867	1969
Max. gross vehicle mass （lbs）		4307	4367	4469
Seating capacity (persons)		2	2	4
axle mass （Unladen, lbs）	Front	907	937	989
	Rear	900	930	980
axle mass （Laden, lbs）	Front	1771	1758	1838
	Rear	2536	2609	2631

3. Main performance parameter

Item	LZ970-1	LZ970-2	LZ970-3
Max. speed	88(km/h)/55mile/h		
Max. grade ability（%）	30		
Min. turning diameter （m）	9.5		
Min. ground clearance （mm）	155		
Approach angle /Departure angle（°）	31/30		

4. Engine parameter

Item	LZ970-1	LZ970-2	LZ970-3
Engine type	DA465Q	JB465QE 1	
Engine form	Four-in-line four-stroke water-cooled SOHC, 8valves, multi-point MPI		
Total displacement(ml)	970	970	
Cylinder bore (ml)	65.5	65.5	
Stroke (mm)	72	72	
Compression ratio	8.8	10.0	

Rated output(kW/ r/min)	35.5/5000	44/5500
Max. torque (N·m/r/min)	74/3000～3500	84/3000～4000
Idling speed (r/min)	850±50	850±50
Min. fuel consumption (g/kW•h)	275	270
Fuel	93# or above Unleaded gasoline	

5. Transmission system

Item		LZ970-1	LZ970-2	LZ970-3
Clutch type		Single-disc, dry and diaphragm-spring		
Transmission type		ynchronous gear mesh, 5 forward gears and 1 reverse gear with H/L		
Final drive ratio		5.125		
Gear Internal gearbox ratios	1 st Shift	3.652	3.505	3.769
	2 nd Shift	1.948	2.043	2.045
	3 rd Shift	1.424	1.383	1.376
	4 th Shift	1	1	1
	5 th Shift	0.795	0.806	0.838
	Reverse	3.466	3.505	4.128
	H	1	1	1
	L	1.870	1.870	1.870

6. Steering system

Item	Parameter
Steering gear	rack and pinion
Wheel Camber	1° 30′ ±30′
Wheel kingpin inclination	9° 30′ ±1° 30′
Wheel caster	3° 00′ ±30′
Wheel Toe In (mm)	2～5

7. Running gear

Item	Parameter
Tire type	65/70R13(155R13C); 24*8-12(optional, special design for mini truck only)
Tire pressure, Unladen (front/rear, kPa)	210/210 (200/200)
Tire pressure, Laden (front/rear, kPa)	230/300 (220/350)
Front suspension	Strut and link independent suspension
Rear suspension	Leaf spring dependent suspension

8. Baking system

Item	Parameter
Braking system type	Dual－circuit hydraulic brake
Front wheel brake	Disc brake
Rear wheel brake	Drum brake
Parking brake	Mechanism cable

1.2 Marking plate and code

1. Marker plate and code No.

Factory marker plate is fixed on the bracket of wiper.

2. Engine code

DA471QLR series engine number is stamped on the engine cylinder and valve chamber cover.

Other series are stamped on the engine cylinder of the inlet manifold side.

3. The vehicle identification No.（VIN）

The vehicle identification No. (VIN) is stamped on the upper surface of the right plate in the engine cabin and it is also stamped on the right side of instrument panel near the windscreen.

2 INSPECTION DATA AND MAINTENANCE PERIOD

2.1 TORQUE

The tightening performance of connecting bolt and nut is performed by screw thread. Each fastener should be tightened to the torque specified in each section with moment wrench during maintenance.

TABLE2-1

System	Tighten position		Specified torque(N • m)	
			N • m	kgf • m
Engine	Cylinder head setscrew		55～60	5.5～6.0
	Connection rod bearing cover retaining nut *		35±2	3.5±0.2
	Spark plug		20～30 18～22*	2.0～3.0 1.8～2.2*
	Intake and exhaust manifold nut		18～23	1.8～2.3
	Intake manifold nut	M6	11～12	1.1～1.2
		M8	21～25	2.1～2.5
	Setscrew of air intake manifold bracket*		21～25	2.1～2.5
	Exhaust manifold setscrew and retaining nut *		21～25	2.1～2.5
	Engine front hanger setscrew *		21～25	2.1～2.5
	Tensioner setscrew		10～12	1.0～1.2
	Synchronous gear setscrew on crankshaft		50～60	5.0～6.0
	Crankshaft bearing cover*		10～12	1.0～1.2
	Cylinder orifice *		5	0.5
	Valve adjust nut		15～20	1.5～2.0
	Synchronous chain cover setscrew		3～4	0.3～0.4
	Synchronous chain cover setscrew	M6	10～12	1.0～1.2
		M8	21～25	2.1～2.5
	Setscrew of oil pump		4～5	0.4～0.5
	Oil collector setscrew *		10～12	1.0～1.2
	Sump nut*		10～12	1.0～1.2
	Setscrew of crankshaft wheel belt *		115±10	11.5±1.0
	Synchronization gear setscrew of crankshaft		50～60	5.0～6.0
	Connecting rod bearing shell nut		28～32	2.8～3.2
	Crankshaft bearing cap setscrew		43～48	4.3～4.8
	Flywheel mounting setscrew		40～45	4.0～4.5

Oil pressure sensor		12～15 12*	2～1.5 1.2*
Setscrew of oil filter nib		20～25	2.0～2.5
Engine rear mounting nut and rear hanger bolt		11～14	1.1～1.4
Oil pump safety valve spring seat		15～20	1.5～2.0
Sump setscrew		4～5	0.4～0.5
Oil drain plug		20～25	2.0～2.5
Left and right engine hangers fastening bolt a		20～30	2.0～3.0
Transmission and cylinder setscrew and nut		45～55	4.5～5.5
Bracket mounting bolt		25～30	2.5～3.0
Valve chamber cover setscrew		4～5 10～12*	0.4～0.5 1.0～1.2
Tension pulley bracket bolt and nut		15～23	1.5～2.3
Rear engine bracket-Body fastening bolt		17～28	1.7～2.8
Engine beam-Body fastening bolt		45～50	4.5～5.0
Engine beam-LH and RH damper retaining nut		18～23	1.8～2.3
O_2 sensor		40～60	4.0～6.0
Coolant temperature sensor		Max.20	Max.2.0
Throttle valve body mounting setscrew		8～10	0.8～1.1
Crank shaft position sensor setscrew		8～10	0.8～1.1
Crankcase setscrew*	Inside	53~59	5.3~5.9
	Outside	20~25	2.0~2.5
Intake pressure sensor setscrew		8～10	0.8～1.1
Coolant temperature sensor		15～20	1.5～2.0
Rocker chamber head setscrew		4.0～5.0	0.4～0.5
TIMING CHAIN GUIDE BOLT*		9	0.9
Flywheel disc setscrew*		65.5~72.5	6.55~7.25
Idler wheel setscrew*		45～55	4.5～5.5
Speed sensor setscrew *		10～12	1.0～1.2
Ignition shock sensor setscrew *		21~25	2.1~2.5

Clutch	Clutch pressure plate setscrew	18～28	1.8～2.8
Transmission	Transmission mounting setscrew	40～50	4.0～5.0
	Transmission bolt（8mm）	18～28	1.8～2.8
	Transmission bolt（6mm）	8～12	0.8～1.2
	Oil drain and fill plug	25～30	2.5～3.0
Gear Shifting Control	Cable nut	22～35	2.2～3.5
Rear axle assembly	Driven gear and differential housing bolt	65～70	6.5～7.0
	Crave bevel pinion nut	170～220	17～22
	Carrier and final drive housing bolt	34～40	3.4～4.0
	Drain plug	50～70	5.0～7.0
	Fill plug	40～65	4.0～6.5
	Final drive and rear axle housing bolt	25～30	2.5～3.0
	Rear brake and rear axle housing bolt	18～28	1.8～2.8
Propeller Shaft assembly	Propeller Shaft and final drive flange nut	18～28	1.8～2.8
Suspension	Strut support nut	65～85	6.5～8.5
	Strut bracket bolt and nut	80～110	8～11
	Tension rod and front control arm nut	80～110	8～11
	Front control arm (Steering knuckle side)	45～65	4.5～6.5
	Front control arm (Body side)	58～78	5.8～7.8
	Front stabilizer bar and tension rod bracket bolt	23～30	2.3～3.0
	Tension rod bracket and body bolt	45～65	4.5～6.5
	Tension rod bracket and stabilizer link nut	18～28	1.8～2.8
	Stabilizer link and stabilizer bar nut	40～60	4.0～6.0
	Leaf spring U type bolt and nut	30～45	3.0～4.5
	Leaf spring front nut	45～70	4.5～7.0

	Leaf spring rear nut	30～55	3.0～5.5
	Rear absorber upper nut	22～35	2.2～3.5
	Rear absorber lower nut	10～16	1.0～1.6
Steering	Steering wheel nut	28～38	2.8～3.8
	Steering column bolt	10～20	1.0～2.0
	Steering lower shaft and steering gear bolt	20～30	2.0～3.0
	Steering gear bolt	20～30	2.0～3.0
	Tie rod lock nut	40～50	4.0～5.0
	Tie rod and knuckle nut	35～45	3.5～4.5
	Front crossmember bolt	90～100	9.0～10
Brake	Wheel nut	80～90	8.0～9.0
	Spare bracket mounting bolt	8～12	0.8～1.2
	Front brake bleeding screw	7～9	0.7～0.9
	Caliper mounting bolt	70～100	7.0～10
	Knuckle and front hub nut	175～190	17.5～19.0
	Rear brake bleeding screw	7～10	0.7～1.0
	Rear brake mounting bolt	18～26	1.8～2.6
	Booster mounting nut	11～17	1.1～1.7
	Master cylinder and booster nut	8～12	0.8～1.2
	Mounting bolt of brake pedal bracket	20～26	2.0～2.6
	Parking brake lever mounting bolt	10～14	1.0～1.4
	Parking brake cable mounting bolt	10～14	1.0～1.4
	Proportioning value mounting bolt	10～12	1.0～1.2
	Connector mounting nut	10～12	1.0～1.2
	Brake pipe nut	15～18	1.5～1.8
	Front brake hose and brake	15～18	1.5～1.8
	Six connector mounting bolt	10～12	1.0～1.2
	Front, rear sensor bolt	8～10	0.8～1.0
Body	Outer rearview mirror mounting setscrew	6.8～8.3	0.7～0.9
	Middle, rear seat mounting bolt	18～28	1.8～2.8
	Safety belt mounting bolt	34～54	3.4～5.4
	Upper slide rail mounting bolt	4～6	0.4～0.6
	Front door lock body mounting bolt	6.8～8.3	0.7～0.9

	Front door lock ring mounting bolt	26～32	2.6～3.2
	Front door limiting stopper mounting bolt	6.8～8.3	0.68～0.83
	Front door hinge mounting bolt (body side)	20.6～32.3	2.1～3.3
	Front door hinge mounting bolt (door side)	16.7～25.5	1.7～2.6
	Sliding door lock body mounting bolt	6.8～8.3	0.7～0.9
	Sliding door lock ring mounting bolt	26～32	2.6～3.2
	liding door guide wheel bracket mounting bolt	20～28	2.0～2.8
	Sliding door hinge mounting bolt	27.6～33.8	2.8～3.4
	Tail door gas spring mounting bolt (side wall side)	11～15	1.1～1.5
	Tail door gas spring mounting bolt (tail door side)	6.66～9.94	0.67～1.0
	Tail door bump stopper mounting bolt	8.4～11.1	0.84～1.1
	Tail door hinge mounting bolt	20～28	2.0～2.8
	Tail door license plate mounting bolt	4.5～6.0	0.45～0.6
	Tail door lock ring mounting bolt	26～32	2.6～3.2
	Tail door lock body mounting bolt	6.8～8.3	0.68～0.83
	Front engine hood hinge mounting bolt	6.66～8.14	0.67～0.81

Note ：The data with“*” is for DA471QLR series engine.

2.2 INSPECTION DATAS

ENGINE（TABLE 2-2） TABLE 2-2

<table>
<tr><th colspan="5">Item</th><th>Standard</th><th>Limit</th></tr>
<tr><td colspan="3" rowspan="2">Compressed pressure</td><td colspan="2">Design value</td><td>1421kPa(300rpm/min)
1250kPa（12.5kg/cm²）*</td><td>1127kPa(300rpm/min)
900kPa（9.0kg/cm²）*</td></tr>
<tr><td colspan="2">Deference between any two cylinder</td><td>≤98kPa(300rpm/min)
≤100kPa（1.0kg/cm²）*</td><td>≤98kPa(300rpm/min)
≤100kPa（1.0kg/cm²）*</td></tr>
<tr><td colspan="2" rowspan="4">Valve distance</td><td rowspan="2">Intake</td><td colspan="2">Cooling procedure</td><td>0.08mm
0.17～0.23mm*</td><td>——</td></tr>
<tr><td colspan="2">Hot procedure</td><td>0.1mm
0.21～0.27mm*</td><td>——</td></tr>
<tr><td rowspan="2">Exhaust</td><td colspan="2">Cooling procedure</td><td>0.1mm
0.17～0.23mm*</td><td>——</td></tr>
<tr><td colspan="2">Hot procedure</td><td>0.12mm
0.17～0.23mm*</td><td>——</td></tr>
<tr><td colspan="5">Spark angle advance</td><td>8° ～12° （before TDC）
6° ~7° （idling）*</td><td>——</td></tr>
<tr><td rowspan="21">Camshaft, spindle and valve *</td><td colspan="2" rowspan="6">Camshaft</td><td rowspan="2">Cam height</td><td>Intake（mm）</td><td>38.06~38.22</td><td>37.93</td></tr>
<tr><td>Exhaust（mm）</td><td>37.90~38.06</td><td>37.77</td></tr>
<tr><td colspan="2">Camshaft vibration</td><td>——</td><td>0.1mm</td></tr>
<tr><td colspan="2">Radial clearance of camshaft cover（mm）</td><td>0.045-0.087</td><td>0.12</td></tr>
<tr><td colspan="2">Diameter of camshaft bearing hole</td><td>23.00~23.021</td><td></td></tr>
<tr><td colspan="2">Diameter of camshaft journal（mm）</td><td>22.934~22.955</td><td></td></tr>
<tr><td colspan="2" rowspan="3">Spindle</td><td colspan="2">Out diameter of spindle (mm)</td><td>26.959~26.975</td><td>——</td></tr>
<tr><td colspan="2">Diameter of spindle hole (mm)</td><td>27.000~27.021</td><td>——</td></tr>
<tr><td colspan="2">Copulate clearance (mm)</td><td>0.025~0.062</td><td>0.15</td></tr>
<tr><td rowspan="12">Valve</td><td rowspan="12">Valve stem guide seat</td><td rowspan="2">Valve stem O.D (mm)</td><td>Intake</td><td>5.465~5.480</td><td>——</td></tr>
<tr><td>Exhaust</td><td>5.440~5.455</td><td>——</td></tr>
<tr><td rowspan="2">Valve guide seat O.D (mm)</td><td>Intake</td><td rowspan="2">5.500~5.512</td><td rowspan="2">——</td></tr>
<tr><td>Exhaust</td></tr>
<tr><td rowspan="2">Valve guide-to-stem clearance (mm)</td><td>Intake</td><td>0.020~0.047</td><td>0.07</td></tr>
<tr><td>Exhaust</td><td>0.045~0.072</td><td>0.09</td></tr>
<tr><td rowspan="2">Valve stem end movement limit (mm)</td><td>Intake</td><td>0.14</td><td>——</td></tr>
<tr><td>Exhaust</td><td>0.18</td><td>——</td></tr>
<tr><td rowspan="2">Thickness of valve head (mm)</td><td>Intake</td><td>1.0</td><td>0.7</td></tr>
<tr><td>Exhaust</td><td>1.5</td><td>0.5</td></tr>
<tr><td rowspan="2">Valve head contact and sealing width (mm)</td><td>Intake</td><td>2.228~3.428</td><td>——</td></tr>
<tr><td>Exhaust</td><td>1.987~3.387</td><td>——</td></tr>
</table>

Cylinder head	Cylinder-to –contact surface declination (mm)			0. 03mm	0. 05mm
	Manifold install surface declination			0. 05mm	0. 1mm
	Valve seat contact width (mm)*	Intake		1. 57-1. 97mm	——
		Exhaust		1. 57-1. 97mm	——
	Valve spring perpendicular degree ＊			——	2. 0mm
Valve	Valve guide I.D			5. 5～5. 12mm	——
	Valve guide-to-stem clearance			Intake 0～0. 047mm, Exhaust 0～0. 027mm	——
Cylinder	Cylinder-to –contact surface declination (mm)			0. 06mm	0. 05mm*
	I.D (mm)			65. 5～65. 502mm	71. 070 mm*
	Difference between I.D			——	0. 05mm
	Wear limit of cylinder			——	0. 05mm
	Cylinder-to –piston surface clearance			0. 04～0. 06mm 0. 02~0. 04 mm*	——
	Conicity and ellipticity ＊			——	0. 10mm
Piston	Piston O.D	Standard		65. 465～65. 485 70.970~70.990mm*	——
		Enlarge dimension ＊	0.25mm	71.220~71.240mm	——
			0.5mm	71.470~71.490mm	——
	Ring joint distance when assembly	NO.1 ring		1. 53～1. 55mm 0. 03~0. 07 mm*	
		NO.2 ring		1. 52～1. 54mm 0. 02~0. 06 mm*	
		Oil ring		2. 81～2. 83mm 0. 06~0. 15 mm*	
	Piston pin O.D ＊			16. 995~17. 000 mm	——
	Piston pin I.D			15. 99～16mm 17. 006~17. 014 mm*	
	Piston pin-to-connecting rod clearance			0. 0125～0. 0175mm 0.003~0.016mm*	0. 05mm
Piston ring	Ring thicknes	NO.1 ring		1. 47～1. 49mm	
		NO.2 ring		1. 47～1. 49mm	

	s	Oil ring	0.45mm	
	Clearance between and groove	NO.1 ring	0.040～0.075mm	0.12mm
		NO.2 ring	0.030～0.065mm	0.10mm
	Piston ring end clearance	NO.1 ring	0.15～0.35mm	0.7mm 0.8mm*
		NO.2 ring	0.15～0.35mm 0.30～0.50mm*	0.7mm 1.1mm*
		Oil ring	0.3～0.9mm 0.10～0.40mm*	1.8mm 1.6mm*

Item				Standard	Limit
Crank shaft and connecting rod	Cam shaft spindle （3#）vibration			——	0.06mm 0.04mm*
	Axial movement of camshaft *			0.11-0.31mm	0.35mm
	Journal diameter			37.985～38mm	——
	Crankshaft and connecting rod brass clearance			0.02～0.043mm 0.020-0.040mm*	0.08mm 0.065mm*
	Journal diameter*		1	44.994-45.000mm	——
			2	44.988-44.994mm	——
			3	44.982-44.988mm	——
	Main bearing hole diameter（without brass）*	Marked digital	1	49.000-49.006mm	——
			2	49.006-49.012mm	——
			3	49.012-49.018mm	——
	CRANKSHAFT THRUST BEARING THICKNESS*		Standard	2.500mm	——
			Large size:0.125 mm	2.563mm	——
	Thickness of	Identify marks	5	1.999~2.003mm	——
			4	2.002~2.006mm	——
			3	2.005~2.009mm	——

bearing shell *		2	2.008~2.012mm	——
		1	2.011~2.015mm	——
		0	2.014~2.018mm	——
Crankshaft jounel planeness and coning *			——	0.01mm
Connecting rod small end hole diameter			16.005～16.015mm	——
Journal			49.985～50mm	——
Crankshaft spindle and brass clearance			0.022～0.041mm 0.020-0.040mm*	0.08mm 0.065mm*
Connecting rod big end strut interval			0.36～0.59 0.26-0.49mm*	0.7mm 0.53mm*
Pin *	Diameter	Mark1	41.994～42.000	——
		Mark 2	41.988～41.994	
		Mark 3	41.982～41.988	
	Circularity and taper		——	0.01mm
Connecting rod	Bent		0.05mm	0.05mm
	Distortion		0.1mm	0.1mm

Note： the data with “*” is for DA471QLR series engine.

Clutch and transmission（TABLE2-3） TABLE2-3

Item			Standard	Limit
Clutch	Rivet head depth		1.2mm	0.5mm
	Spline side clearance			0.8mm
Transmission	Gear and ring clearance	Low gear, high gear	1.0～1.4mm	0.5mm
		5th gear	1.2～1.6mm	0.5mm
	Synchronizer ring groove width		10.1mm	10.4mm
	Fork spring free height		25.5mm	21.0mm
	Gear clearance		0.06～0.15mm	0.3mm

Lubricating system（TABLE2-4） TABLE2-4

Item	Standard	Limit

Lubricating system	Radial clearance of gear outside circle	0.12～0.20mm	0.30mm
	Oil pump gear side clearance	0.045～0.120mm	0.17mm
	Oil pressure switch pre-pressure	19.6～39.2kPa	
	Engine oil pressure	0.294～0.44MPa	

● Cooling system (TABLE2-5) TABLE2-5

Item		Standard	Limit
Cooling system	Clam down 100N pressure on the belt between generator and water pump	7～10mm	10～15mm
	Temperature at which thermostat valve begins to open	82℃	
	Temperature at which thermostat valve become fully open	95℃	
	Thermostat valve lift	8mm	

● Final drive assembly （TABLE （2-6)） TABLE 2-6

Item		Standard	Limit
Final drive assembly	Mesh clearance of drive, driven gear	0.10～0.20mm	
	Half-axle gear thrust clearance	0.37 mm(max)	
	Drive gear bearing start torque	0.588～0.882N.m	

● Suspension (TABLE2-7) TABLE 2-7

Item		Standard	Limit
Suspension	Stroke of front shock absorber	104 mm	
	Stroke of rear shock absorber	160 mm	
	Height of rear spring	128 mm	
	Height of front spring	285.5 mm	
	Leaf spring length	995 mm	
	Camber	1° 30′	
	Caster	3° 00′	
	King-pin angle	9° 30′	

● Steering system (TABLE2-8) TABLE 2-8

Item		Standard	Limit
Steering system	Steering angle (inner)	39°	
	Steering angle (outer)	36°	
	Steering wheel play	0～30 mm	
	Steering gear rotation torque	1.1 N.m	

	Pinion and rack steering gear travel	147 mm	
	Toe in	2～5 mm	

- **BRAKE SYSTEM** (TABLE2-9) TABLE 2-9

Item		Standard	Limit
Brake system	Thickness, Front brake disc	12.0 mm	10.0mm
	Run out, Front brake disc		0.15mm
	Pad thickness, Front brake	15.5 mm	6.5mm
	Lining thickness, Rear brake	7.0 mm	3.0mm
	Inside diameter, Brake drum	220 mm	222mm
	The distance between the brake pedal and the floorboard (depress the pedal with 300N force)	145mm	

- COMBINATION INSTRUMENT (TABLE2-10)

TABLE2-10

Speedometer	Real (Km/h)	20	40	60	80	100	120	140	160	180
	Indication (Km/h)	—	40^{+5}_{0}	60^{+5}_{0}	80^{+5}_{0}	100^{+5}_{0}	120^{+6}_{0}	140^{+7}_{0}	160^{+8}_{0}	—
	Vibration	35~150km/h; Less than 2km/h								
Tachometer	Real (rpm)	1000	2000	3000	4000	5000	6000	7000	8000	
	Indication (rpm)	1000 ±100	1000 ±200	1000 ±200	1000 ±200	1000 ±200	1000 ±300	1000 ±350	1000 ±400	
	Vibration	1600~6400r/min; Less than 80 r/min								

Fuel meter	Scale	E (I)	1/2 (V)	F (IX)
	Resistance (Ω)	90	32.5	6.4
	Tolerance (Ω)	+20 -10	+7 -6	+4 -2.5
Water temperature meter	Scale	III	VII	IX
	Temperature (℃)	64	97	115
	Resistance (Ω)	89	30	18.3
	Tolerance (℃)	+8 -12	+10 -4.5	+4 -5

2.3 MAINTENANCE SCHEDULE

Maintenance timetable for normal driving.

TABLE 2-11

	Interval: This interval should be judged by odometer reading or months, whichever comes first.		2.5	10	20	30	40	50	60	70	80
		km×1000	2.5	10	20	30	40	50	60	70	80
		months	2	6	12	18	24	30	36	42	48
ENGINE											
1	Water pump(fan) drive belt(tension, damage)		A	—	I	—	R	—	I	—	R
2	synchronizing toothed belt （wear and damage）		I	—	I	—	I	—	I	—	I
3	IN and EH valve clearance		A	—	A	—	A	—	A	—	A
4	Valve lash (clearance)*		—	—	I	—	I	—	I	—	I
5	Engine bolts (All cylinder head and manifold fixings)		T	—	T	—	T	—	T	—	T
6	Engine oil filter		R	R	R	R	R	R	R	R	R
7	Engine oil		Replace every 5000km. More frequent replacement if under dusty driving conditions								
8	Fuel hoses and connections (hoses aging , connections crack, damage or loosening)		I	I	I	I	I	I	I	I	I
9	Cooling system hoses and connections （leakage, damage）		—	—	I	—	—	I	—	—	I
10	High tension cords (aging and damage)		—	—	I	—	—	I	—	—	I
11	High tension damping wire *		—	—	I	—	I	—	I	—	R
12	Spark plugs		—	R	R	R	R	R	R	R	R
13	Ignition wiring *			—	I	—	I	—	I	—	I
14	Air filter		Clean every 1000km on asphalt road and clean every 2500km on dusty road								
15	Air filter core*	Pitch road	—	—	—	—	R	—	—	—	
		Dust road	Check referring to hard driving								
16	Acceleration cable and throttle valve spindle		—	I. L	I. L	I. L	I. L	I. L	I. L	I. L	I. L
17	Fuel filter		—	—	—	—	R	—	—	—	R
18	Oil filter *		Replace every 100,000 km								
19	PCV valve		—	—	I	—	I	—	I	—	I
				—	—	—	—	—	—	—	I*

20	Gear oil of transmission (check leakage at normal level)	R	I	I	I	R	I	I	I	R
21	Damage and fastness of harness	I	I	I	I	I	I	I	I	I
22	Coolant	—	—	—	—	R	—	—	—	R
23	Drain system*	—	—	I	—	I	—	I	—	I
24	Wiring harness and connector*	—	—	—	—	I	—	—	—	I
25	Catalytic converter	—	—	—	—	—	—	—	—	I
26	Rocker chamber head breather tube and connector	—	—	I	—	—	I	—	—	I
27	Crankcase hose and nib	—	—	I	—	—	I	—	—	I
28	※ Ignition shock sensor tightening torque	A	A	A	A	A	A	A	A	A
29	※ Distributor cap and rotor (wear and damage)	—	—	I	—	—	I	—	—	I
30	Charcoal canister	Replace every 50000km. More frequent check if under dusty driving condition. Replace in time if clogging or liquid fuel found.								
31	Canister control valve *	—	—	—	—	—	—	—	—	I
32	Clutch pedal play	I	I	I	I	I	I	I	I	I
33	Brake discs and pads (wear, damage) Brake drums and shoes (wear, damage)	-	I	I	I	I	I	I	I	I
34	Brake hoses and pipes (leakage, damage, clamp)	-	I	I	I	I	I	I	I	I
35	Brake fluid(lever、leakage)	I	I	I	I	R	I	I	I	I
36	Brake pedal (pedal-to-wall clearance)	I	I	I	I	I	I	I	I	I
37	Brake lever and cable (stroke and damage)	I	I	I	I	I	I	I	I	I
38	Tires (abnormal wear and pressure)	-	I	I	I	I	I	I	I	I
39	Wheel, wheel nut(damage、torque)	I	I	I	I	I	I	I	I	I
40	Shock absorber(oil leakage 、 damage)	I	I	I	I	I	I	I	I	I
41	Propeller shaft (damage, tightness)	-	-	I	-	I	-	I	-	I

42	Differential oil (leakage, lever)	R	I	I	I	R	I	I	I	R
43	Suspension and steering (tightness, damage, rattle, breakage)	I	I	I	I	I	I	I	I	I
44	Test drive	Test drive on completion of each service								

Notice one: "*" is for DA471QLR and "※" is for DA465Q-1A , United automotive electronic system Co.,Ltd

Notice two: "R" —Replace or repair; "I" —Inspection and correct or replace if necessary; "T" —Tighten to the specified torque; "L" —Lubricate; "A" —Inspection and connect

3 TROUBLE SHOOTING

3.1 ENGINE

TABLE 3-1

Condition	Possible cause	Correction
Poor starting	Starter will not run 1. Main fuse blown off 2. Contact not closing in main switch, or this switch open-circuited 3. Run-down battery 4. Defective magnetic switch of starter 5. Loose battery terminal connection 6. Defective brushes in starter 7. Loose battery cord connection 8. Open in field or armature circuit of starter	 Replace Repair or replace Recharge Repair Clean and retighten Replace Retighten Repair or replace
	No sparking 1. Defective spark plug 2. High tension cord short-circuit (grounded) 3. Contact not closing positively in main switch, or this switch open-circuited 4. Loose or blown fuse 5. Defective ignition coil	 Adjust gap, or r replace Repair or replace Replace Set right or replace Replace
	Faulty intake and exhaust systems 1. Clogged air cleaner. 2. Clogged exhaust pipes 3. Leaky intake system.	 Clean or replace Clean Adjust

	Abnormal engine internal condition	
	1. Ruptured cylinder head gasket	Replace
	2. Improper valve clearance	Adjust
	3. Weakened or broken valve spring	Replace
	4. Loose manifold, permitting air to be drawn in	Tighten and , as necessary, replace gasket
	5. Worn pistons, rings or cylinders	Replace worn rings and pistons as necessary
	6. Broke valve timing belt	Replace
	7. Poor valve seating	Replace or repair
	8. Wrong kind of engine oil	Replace
	9. Burnt valves	Replace
	Malfunction of EMS system	
	1. Crankshaft position sensor	Check wire for damage
	2. Intake temperature pressure sensor	Check wire for damage
	3. Water temperature sensor	Check wire for open or short
	4. Repeating motor	Check connection or state
	5. Fuel pump assembly	Check wire for normal work
	6. Electrical controller	Check wire for damage
Not enough power	Inadequate compression	
	1. Air cleaner dirty and clogged	Clean or replace
	2. Improper valve clearance	Adjust
	3. Valves not eating tight	Repair
	4. Valve stems tending to seize	Replace
	5. Broken or weakened valve spring	Replace
	6. Piston rings seized in grooves, or broken	Replace
	7. Worn pistons, rings or cylinders	Replace worn parts and rebore as necessary
	8. Leaky cylinder head gasket	Replace
	Improperly timed ignition	
	1. Improper ignition timing	Adjust
	2. Defective spark plug	Replace
	3. Leaks, loose connection or disconnection of high tension cord	Connect or replace as necessary
	4. Ignition wire aging	Replace
	Fuel system	
	1. Defective fuel pump or insufficient pressure	Repair or replace
	2. Clogged fuel filter	Replace
	3. Float level out of adjustment	Adjust
	4. Clogged fuel pipe	Clean or replace
	5. Loose joint in fuel system	Retighten
	Exhaust systems	
	1. Clogged muffler	Clean or replace
	Malfunction of EMS system	
	1. Throttle position sensor	Check or replace
	2. Intake temperature pressure sensor	Check or replace
	3. Oil tail	Check fuel injector and pressure regulator valve
	4. Water temperature sensor	Check or replace

	Others 1. Dragging brakes 2. Slipping clutch 3. Too low battery voltage results in abnormal work of ECU.	 Adjust Adjust or replace Recharge or replace battery
Engine hesitates (Momentary lack of response as the accelerator is depressed. Can occur at all car speeds. Usually most severe when first trying to make the car move, as from a stop sign.	Electrical systems 1. Spark plug gap out of adjustment 2. Deteriorated ignition coil, or crack resulting in leakage 3. Leaky high-tension cords 4. Ignition timing out of adjustment	 Adjust gap Replace Replace Adjust as prescribed
	Fuel system 1. Malfunctioning accelerator pump 2. Fuel tubes break	 Replace Replace
	Malfunction of EMS system 1. Engine rotate speed exceeding interruption fuel rotate speed 2. Check if electrical controller open for short 3. Check electrical controller electrical source wire for open 4. Open or damaged crankshaft position sensor	 Check for low gear Replace Repair Repair or replace
	Others 1. Leady cylinder head gasket result in cylinder compress pressure descending 2. Worn pistons, rings or cylinders or burnt valves result in low compress pressure	 Replace Replace and rebore as necessary
Surges (Engine power variation under or cruise. Feels like the car speeds up and down with no change in the accelerator pedal.)	Ignition system 1. Improper ignition timing 2. Defective spark plug or improper gap 3. Leaky or loosely high tension cord	 Adjust Adjust Replace
	Malfunction of EMS system 1. Throttle position sensor damaged 2. Intake temperature pressure sensor	 Check or replace Check or replace
	Others 1. Air cleaner dirty or clogged 2. Deposit carbon on exhaust pipe 3. Clogged muffler 4. Too low compress pressure 5. Poor valve seating 6. Improper valve clearance 7. Pistons tending to seize 8. Bearing shell tending to seize	 Clean Clean Clean Replace worn parts and rebore as necessary Repair Adjust Replace piston and rebore as necessary。 Replace

Erratic idling	Ignition system 1. Improper ignition timing 2. Defective spark plug or excessively large clearances 3. Leaky high tension cord.	 Adjust Replace or adjust Replace
	Malfunction of EMS system 1. Repeating motor 2. Electrical controller 3. Intake temperature pressure sensor	 Check or replace Replace Check or replace
	Others 1. Air cleaner dirty or clogged 2. Leaky intake system. 3. clogged exhaust manifold 4. Improper valve clearance 5. Poor valve seating 6. Blown cylinder head gasket	 Clean Adjust Clean or replace Adjust Repair Replace
Abnormal detonation	Ignition system 1. Spark plug tending to overheat 2. Improper ignition timing	 Change plug heat value Adjust
	Fuel system 1. Improper engine oil grade	 Replace with proper grade oil
	Malfunction of EMS system 1. Knock sensor 2. Intake temperature pressure sensor	 Replace Replace
	Others 1. More carbon deposit on piston top or cylinder head 2. Damaged cylinder gasket result in too low compress press. 3. Improper valve clearance 4. Pistons tending to seize 5. Weakened valve spring	 Clean Replace Adjust Repair or replace Replace
Overheating	Ignition system 1. Improper ignition timing 2. Wrong heat value of spark plugs	 Adjust Change heat value
	Exhaust system 1. Clogged exhaust pipe hole	 Clean
	Cooling system 1. Not enough coolant 2. loose or broken water pump belt 3. Erratically working thermostat 4. Poor water pump performance 5. leaky radiator cores	 Refill Adjust or replace Replace Replace Repair or replace
	Lubrication system 1. Clogged oil filter 2. Clogged oil strainer 3. Deteriorated oil pump performance 4. Oil leakage from oil pan or pump 5. Improper engine oil grade 6. Not enough oil in oil pan	 Replace Clean Replace Repair Replace with proper grade oil Replenish

	Malfunction of EMS system 1. O_2 sensor 1. Not enough pressure of fuel pump 2. Water temperature sensor	 Replace Adjust or replace Replace
	Others 1. Dragging brakes 2. Slipping clutch 3. Blown cylinder head gasket	 Repair or replace Adjust or replace Replace
Engine noise	Crankshaft noise 1. Worn-down bearings, resulting in excessively large running clearances 2. Worn connecting-rod bearings 3. Distorted connecting rods 4. Worn crankshaft journals 5. Worn crankpins.	 Replace Replace Repair or replace Repair by grinding, or replace crankshaft Repair by grinding, or replace crankshaft
	Noise due to pistons, rings, pins or cylinders 1. Abnormally worn cylinder bores 2. Worn pistons, rings or pins 3. Pistons tending to seize 4. Broken piston rings	 Rebore to next oversize or Replace Replace Replace
	Others 1. Excessively large camshaft thrust play 2. Excessively large crankshaft thrust clearance 3. Valve clearance too large 4. Not enough engine oil	 Replace Adjust Adjust replenish
High fuel consumption	Ignition system 1. Improper ignition timing 2. Leak or loose connection of high tension cord 3. Defective spark plug	 Adjust Repair or replace Replace
	Fuel system 1. Fuel leakage from tank, pipe or carburettor 2. Clogged air cleaner element	 Repair or replace Clean or replace
High fuel consumption	Abnormal condition in engine 1. Cylinder head burnt gas leakage. 2. Poor valve seating 3. Improper valve clearance	 Tighten or replace gasket Repair Adjust
	Others 1. Dragging brakes 2. Slipping clutch	 Adjust or replace Repair or replace

Excessive engine oil consumption	Oil leakage 1. Loose oil drain plug 2. Loose oil pan securing bolts 3. Deteriorated or broken oil pan sealant 4. Leaky oil seals 5. Blown cylinder head gasket 6. Improper tightening of oil filter	 Tighten Tighten Replace Replace Replace Tighten
	"Oil pumping" (Oil finding its way into combustion chambers.) 1. Sticky piston ring 2. Worn piston ring groove and ring 3. Improper location of piston ring gap 4. Worn pistons or cylinders	 Remove carbon and replace rings Replace Replace piston Replace pistons and rebore as necessary
	Oil leakage along valve stems 1. Defective valve stem oil seals 2. Badly worn valves or valve guide bushes	 Replace Replace

3.2 CLUTCH

TABLE 3-2

Condition	Possible cause	Correction
Slipping clutch	1. Loss of clearance at the tip of release fork 2. Clutch facings dirty with oil 3. Clutch facings excessively worn 4. Weakened diaphragm spring 5. Distorted pressure plate or flywheel surface 6. Improper clutch pedal free travel	Adjust as prescribed Replace Replace Replace Replace Adjust and, as necessary, replace clutch facings
Dragging clutch	1. Improper clutch pedal free travel 2. Weakened diaphragm spring or worn spring tip 3. Worn or damaged transmission input shaft splines 4. Worn or damaged front input shaft bearing 5. Excessively wobbly clutch disc 6. Clutch facing broken or dirty with oil	Adjust free travel Replace Replace Replace Replace Replace

Clutch vibration	1. Glazed clutch facings 2. Clutch facing dirty with oil 3. Wobbly clutch disc or poor facing contact 4. Weakened torsion spring 5. Distorted pressure plate or flywheel surface 6. Loose clutch disc rivets 7. Weakened engine mounting or loosened mounting bolt or nut	Repair or replace Replace Replace Replace Replace Replace eplace
Noisy clutch	1. Worn or broken release bearing 2. Input shaft front bearing worn down 3. Excessive rattle of clutch disc hug 4. Cracked clutch disc 5. Pressure plate and diaphragm spring rattling	Replace Replace Replace the disc Replace Replace
Grabbing clutch	1. Oily contamination on clutch disc facing 2. Excessive worn clutch facing 3. Rivet heads showing out of facing 4. Weakened torsion spring	Replace Replace Replace Replace

3.3 TRANSMISSION

TABLE3-3

Condition	Possible cause	Correction
Gear slipping out of mesh	1. Worn shift fork shaft 2. Worn locating steel balls 3. Worn locating steel balls groove 4. Weakened springs for locating steel balls 5. Worn shift fork 6. Excessive rattling in thrust direction of gears or damaged C-ring 7. Damaged gear shift spline (gear outer ring and sleeve) 8. Worn bearings of input shaft, main shaft or countershaft	Repair or replace Replace Replace Replace Replace Replace Replace Replace
Gears refusing to disengage	1. Weakened or broken synchronizer spring 2. Worn inner groove of synchronizer ring 3. Synchronizer ring seized on the cone 4. Distorted shift fork shaft or shift fork 5. Worn shift fork	Replace Replace Replace the ring Replace Replace
Excessive gear noise	1. Not enough oil in transmission 2. Defective synchronizer 3. Gear rattling in thrust direction 4. Damaged or worn bearings	Replenish Replace Replace Replace

Hard shifting	1. Clutch pedal play too large, resulting in a "dragging clutch" 2. Worn clutch disc facings 3. Clutch disc facings dirty with oil 4. Distorted or unevenly worn shift fork shaft 5. Broken locating balls 6. Worn synchronizer sleeve or ring 7. Improper clearance between synchronizer ring and gear	Adjust Replace Replace Replace Replace Replace Replace

3.4 EXHAUST MANIFOLD AND MUFFLER

TABLE 3-4

Condition	Possible cause	Correction
Poor emission	① Damage of TWC and O_2 sensor, which caused by use of lead fuel. ② Damage of TWC and O_2 sensor, which caused by misfire of ignition system. ③ Leakage of exhaust system, ECU can't get the right signal of O_2 sensor, causing air/fuel ratio rich	Replace Replace Repair
Poor muffling performance	①loose exhaust pipe connection ②loose exhaust manifold ③broken manifold, pipe or muffler ④broken muffler gasket ⑤interference between body and muffler	Retighten Retighten Repair or replace Replace Repair, eliminating any contact

3．5 Final drive assembly

Probable cause and maintain way of final drive can see TABLE3-5。

Condition	Possible cause	Correction
Noise of gear	① Improper mesh clearance of drive and driven gear ② wore gear or improper mesh clearance of drive and driven gear ③ Improper mesh of drive and driven gear ④insufficient gear oil or improper sort ⑤driven gear swing when turning or loose drive gear bolt ⑥damaged pinion and gear	Adjust Replace or adjust Adjust Refill or replace Replace or tighten Replace

Noise of bearing	① (period noise) insufficient gear oil or improper sort ② (period noise) wore or damage of bearing ③ (sliding noise) noise of gear ④ (steering noise) half bearing damage	Refill or replace Replace Replace Replace

3. 6 PROPELLER SHAFT

TABLE 3-6

Condition	Possible cause	Correction
Vibration and noise	① Broken or worn bearings of universal joint spider ② Distorted propeller shaft ③ Unbalanced propeller shaft ④loose propeller shaft	Replace Replace Replace Retighten
Noise occurring at standing start or during coasting	①wear or damage of joint ②wear of propeller shaft for bad lubrication ③loose propeller shaft bolt ④loose joint flange bolt	Replace Replace Tighten Tighten

3. 7 BRAKE SYSTEM

TABLE 3-7

Condition	Possible cause	Correction
Not enough braking force	1. Brake oil leakage from brake lines 2. Brake discs or pads stained with oil 3. Overheated brakes 4. Poor contact of shoes on brake drum 5. Brake shoes linings stained with oil or water 6. Badly worn brake shoe linings 7. Defective wheel cylinders 8. Malfunctioning caliper assembly	Locate leak point and repair Clean or replace Find cause and repair Repair or proper contact Replace Replace Repair or replace Repair or replace
Brake Pull (Brake not working in union)	1. Shoe linings stained with oil or water 2. Drum-to-shoe clearance out of adjustment 3. Drum out of round in some brakes 4. Wheel tires inflated unequally 5. Malfunctioning wheel cylinder 6. Disturbed front end alignment 7. Unmatched tires on same axle 8. Restricted brake tubes or hoses 9. Loose suspension parts 10. Loose calipers	Replace Check for inoperative auto adjusting Replace Inflate equally Repair or replace Adjust as prescribed Use same tires on same axle Check for soft hoses and damaged lines. Replace with new hoses and tubes Check all suspension mountings Check and torque bolts to specifications

	11. Malfunctioning caliper assembly	Check for sluggish calipers, proper lubrication of caliper slide bush and caliper slide, and repair or replace
Excessive pedal travel	Partial brake system failure Air in brake system (pedal spongy phenomenon) Rear brake system not adjusted Bent brake shoes Worn brake shoes Insufficient brake fluid in master cylinder reservoirs	Check brake system and replace as necessary Brake system bleeding Adjust rear brakes(Repair auto adjusting mechanism) Replace brake shoes Replace brake shoes Fill reservoirs with approved brake fluid，check brake system for leaks
Dragging brakes（A very light drag is present in all disc brakes immediately after pedal is released）	Master cylinder pistons not returning correctly Restricted master cylinder returning Restricted brake tubes or hoses Incorrect parking brake Weakened or broken return spring in the brake Sluggish parking cables Wheel cylinder or caliper piston sticking	Repair master cylinder Clean Check for soft hoses and damaged lines. Replace with new hoses and tubes Check and adjust to correct specification Replace spring Repair or replace Repair as necessary
Pedal pulsation (Pedal pulsates when depressed for braking)	1.Damaged or loose wheel bearings 2.Rear drums out of round 3.Excessive disc lateral run out	Replace wheel bearings Check run out Check disc as specifications, repair or replace
Braking noise	1. Glazed shoe linings or foreign materials stuck to linings 2. Worn or damaged shoe linings 3. Loose front wheel bearings 4. Distorted backing plates or loose mounting bolts	Repair or replace shoe linings or pads Replace shoe linings or pads Replace bearing Replace back plate, tighten or replace bolts

3.8 SUSPENSION, STEERING SYSTEM AND TIRES

TABLE 3-8

Condition	Possible cause	Correction
Hard steering	Wheel tires not adequately inflated Bind in tie rod end ball stud Disturbed front wheel alignment	Adjust tire pressure Repair or replace Check front wheel alignment
Wobbly steering wheel (Shimmy, shake or vibration)	Wheel tires not adequately inflated Wobbly wheels Large difference in tire diameter between right and left wheels Loose hub nuts	Adjust tire pressure Repair or replace Replace Retighten

	Worn or loose tie rod ends Tire or wheel out of balance Blister or bump on tire Disturbed front wheel alignment	Replace or retighten Balance wheel or replace tire Replace Check front wheel alignment
Steering wheel pulling to one side （car pulls）	Unevenly worn wheel tires Brake dragging in one road wheel Wheel tires unequally inflated Worn or distorted tie rod Disturbed front wheel alignment Loose, bent or broken front or rear suspension parts Bad meshed steering gear	Replace Repair Adjust tire pressure Replace Check front wheel alignment Tighten or replace suspension parts Replace
Shocks coming to steering wheel (or wheel tramp)	Tire inflating pressure too high Poor shock absorber performance Differences in tire diameter among four road wheels Worn steering linkage connections Worn or broken front wheel bearings Loose front wheel Blister or bump on tire Small rotating torque of steering gear	Reduce to the specification Replace Adjust Replace Replace Retighten Retighten Replace
Rapid wear or uneven wear of wheel tires (Abnormal or excessive tire wire)	Wheel tires improperly inflated Differences in diameter among four tires Worn or loose road wheel bearings Wobbly wheel tires Wheel tires improperly “rotated” to result in unbalance Disturbed wheel alignment Hard driving	Adjust tire pressure Adjust or replace Replace Repair or replace Adjust Adjust Replace tire
Steering noise	Loose bolts and nuts Loose leaf spring seat Broken or otherwise damaged wheel bearing Worn or sticky tie rod end Insufficient lubrication on tie rod end	Retighten Retighten Replace Replace Lubricate or replace
Too much play in steering	Worn wheel bearings Steering gear box attachments loose Steering gear box adjustments Wear of tie rod ends or drag rod ball joint	Replace wheel bearing Tighten or repair Check and adjust Replace tie rod end or tie rod

Poor returnability	Bind in tie rod end ball studs Bind in steering column Lack of lubricant steering gear box Disturbed front end alignment Steering gear box adjustment Improper tire pressure	Replace tie rod end Repair and replace Check, lubricate or replace Check and adjust front end alignment Check and adjust gear box torque Adjust pressure
Abnormal noise, front end	Worn, sticky, loose tie rod ends or drag rod ball joint Damaged shock absorbers or mountings Looseness of stabilizer bar	Replace tie rod end, drag rod Replace or repair Tighten bolt or replace bushes
	Loose wheel nuts Loose suspension bolts or nuts Broken or otherwise damaged wheel bearings Broken suspension springs	Tighten Tighten bolts or nuts Replace Replace Replace
Wander or poor steering stability	Mismatched or uneven tires Loose tie rod ends or drag rod Faulty shock absorber or mounting Looseness of stabilizer bar Broken or sagging springs Steering gear box adjustment faulty Front wheel alignment	Replace tire or inflate tires to proper pressure Replace tie rod end or drag rod Replace absorber or repair mounting Tighten or replace stabilizer bar or bushes Replace spring Check or adjust steering gear box torque Check front wheel alignment
Wander or poor steering stability	Broken or sagging springs Overloaded Incorrect springs	Replace Check loading Replace
Ride too soft	Faulty shock absorbers	Replace
Suspension bottoms	Overloaded Faulty shock absorber Incorrect, broken or sagging springs	Check loading Replace Replace
Body leans or sways in corners	Looseness of stabilizer bar Faulty shock absorber or mounting Broken or sagging spring Overloaded	Tighten bolt or replace bushes Replace shock absorber or tighten mounting Replace Check loading

3.9 SPEEDOMETER

TABLE 3-9

Condition	Possible cause	Correction

Faulty indication	① Defective speed sensor ②defective transmission (not enough oil in transmission or worn gears) ③defective speedometer ④ sticky speedometer pointer ⑤Connector trouble	Replace Repair or replace Replace Repair Repair
No indication	①Power wire cut off ②Vehicle speed sensor trouble ③Odometer trouble ④needle clogged ⑤Defective LCD ⑥Harness trouble	Repair Replace Replace Repair Replace Repair

3.10 TACHOMETER

TABLE3-10

Condition	Possible cause	Correction
Fault indication	①Engine crank angle sensor trouble	Replace
	②Engine ECU trouble	Replace
	③Connector trouble	Repair
	④Tachometer trouble	Replace
	⑤Tachometer needle clogged	Repair
No indication	①Power wire cut off	Repair
	②Crank angle sensor trouble	Replace
	③ECU trouble	Replace
	④signal wire open	Repair
	⑤Tachometer trouble	Replace
	⑥Tachometer handle trouble	Repair

3.11 FUEL METER

TABLE 3-11

Condition	Possible cause	Correction
Fault indication	①Fuel sensor trouble (bobber clogged)	Repair or replace
	② Incomplete metal-to-metal contact in terminal connection	Repair
	③the wire connected to fuel sensor ground	Repair
	④Fuel gauge trouble	Replace
	⑤Defective LCD	Replace
No indication	①Power wire of meter open	Repair
	②Fuel level sensor trouble	Replace
	③Harness to fuel sensor open	Repair
	④Fuel gauge trouble	Replace
	⑤Defective LCD	Replace

3.12 WATER TEMPERATURE METER

TABLE 3-12

Condition	Possible cause	Correction
Fault indication	①Defective Water temperature sensor	Replace
	② Incomplete metal-to-metal contact in terminal connection	Repair
	③Harness connected to water temperature sensor ground	Repair
	④Defective water temperature meter	Replace
	⑤Defective LCD	Replace
No indication	①The power wire of gauge open circuit	Repair
	②Defective Water temperature sensor(open circuit)	Replace
	③The harness to water temperature sensor open circuit	Repair
	④Defective water temperature meter	Replace
	⑤Defective LCD	Replace

4 ENGINE

The engine models for the vehicle include DA462-1A、DA465Q、DA465Q－1A、DA465Q－16MC、DA471QLR series ， which adopt BOSCH M1.5.4 EMS or DELPHI MT20 EFI system. Comparing with carburetor engine, a great improvement has made in power, economic and low temperature starting performances.

That the model of engine adopts BOSCH M1.5.4 is DA465Q-1A series, and those adopts DELPHI MT20(U) include DA462-1A、DA465Q、DA465Q-1A、DA465Q-16MC series.

4.1 DA462-1A、DA465Q、DA465Q-1A SERIES ENGINE

4.1.1 GENERAL DESCRIPTION

DA462-1A, DA465Q, DA465Q-1A series engine are in-line 4-cylinders, water-cooled, 4-stroke cycle MPI gasoline unit with valve mechanism arranged for “V”-type valve configuration and overhead camshaft, which is installed in cylinder head and driven by crankshaft with timing chain. With compare to general model, no valve lifter is available in the model, so that valves is driven in more directive method and open or close more promptly (See Fig.4-1a), Fig 4-1 b)).

BOSCH M1.5.4 EMS that has functions of sequential ignition, sequential injection, knock closed-loop control, idle closed-loop control, canister control, A/C control etc, with distributor, is a closed-loop control engine manage system. Sensors available for the system include TPS(throttle position sensor), MAT/MAP(manifold air temperature & pressure sensor), knock sensor, coolant temperature sensor, oxygen sensor, rotation speed sensor (in distributor). The actuators include fuel pump (inside fuel tank), injectors, ignition coils, idle adjustor(also as stepper motor), purge valve.

DELPHI MT20 is a closed-control system, which has functions of grouping ignition, grouping injection, idle closed-loop control, λ closed-control , canister control etc, without distributor. Sensors available for the system include TPS(throttle position sensor), MAT (manifold air temperature sensor), coolant temperature sensor, oxygen sensor, crank angle sensor. The actuators include fuel pump (inside fuel tank), injectors, ignition coils, step regulator(also as step motor), purge valve.

• **ENGINE** CHARACTERISTICS

• Valves in the head is arrayed in V type with inlet pipe and exhaust pipe in configuration of Orthogonal flowing pattern, so that efficiency of charge and exhaust is high.

• Combustion chamber shape is multi-sphere, with low burning consumption and high power performance.

• The camshaft and the rocker arm shaft are installed in the head for more solid construction, which reduce noise from inlet system and quantity of parts in induction system. These make engine more compact.

• The timing chain driving camshaft has characteristics of light weight and small operating noise.

• The engine block uses material of high quality iron-casting and has a construction of gantry for high rigidity.

• The crankshaft are constructed of one-piece forged alloy steel , which supports with five bearings and have an advantage of low vibration.

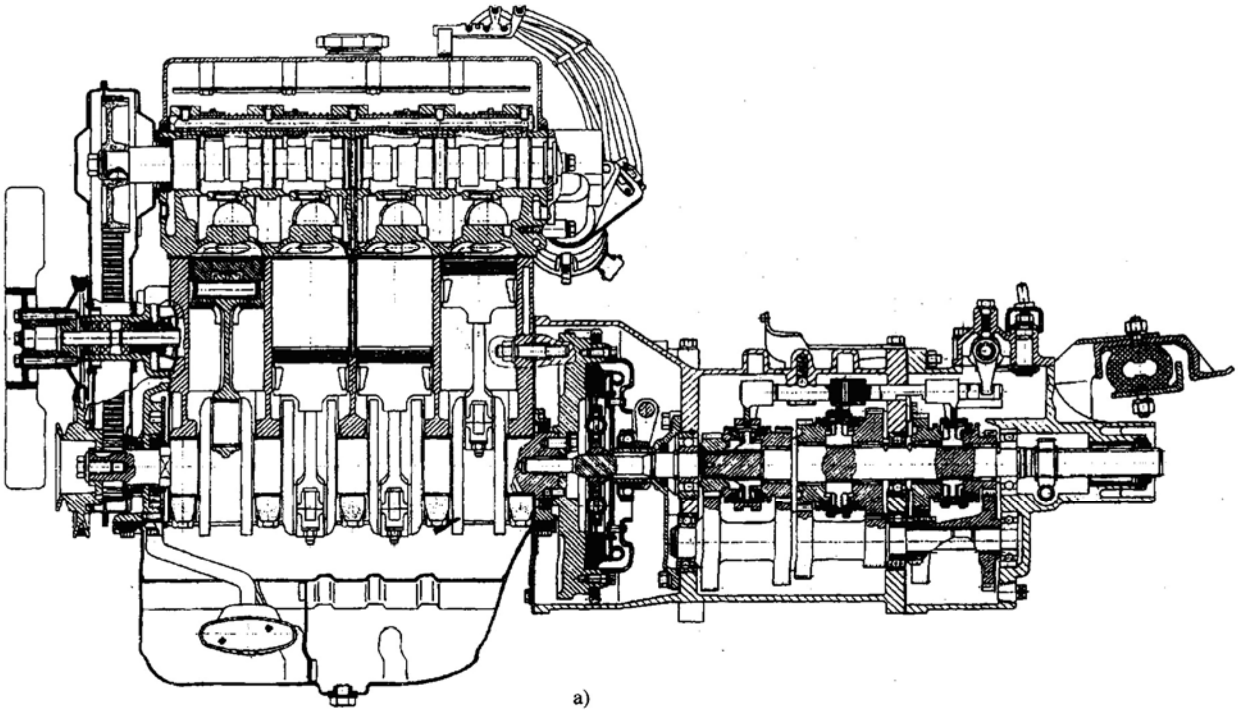
• The exhaust manifold and pipe adopt double pipe type, for no interference with each other. One pipe is connected to 1st and 4th cylinders, the other to 2nd and 3rd cylinders.

• Electronic fuel injection system has a central unite of ECU(electronic control unit), which control accurately quantity of injecting fuel, ignition advance, so that engine works well under varies operation conditions.

• Use three-way catalytic converter to reduce CO, HC and NOx, emissions in exhaust, in order to make the vehicle become GREEN MOTOR.

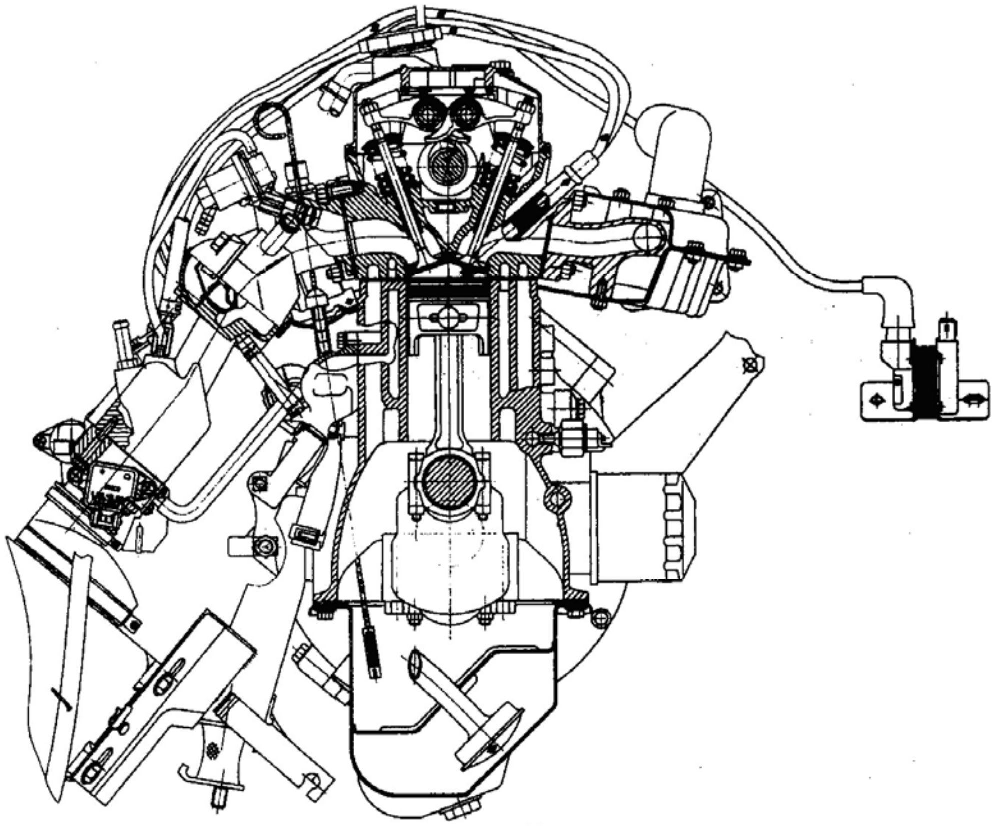
• Crankcase emission controls

Leakage pipeline is located in the block. The leakage flows to the head through crankcase, and fuel is separated from the air with separation plate in the head before it is taken out. Fig.4-1a) Fig. 4-1b)



a)

Fig.4-1



b)

Fig.4-1

4.1.2 PRINCIPLE AND CONSTRUCTION OF EMS

1. Parts

As general electronic control system, there are three portions that construct electronic control fuel injection system: sensors, control unit, actuators.

(1)Sensors

Sensor is a device that responds to a physical stimulus (heat, light, sound, pressure, motion, flow, and so on), and produces a corresponding electrical signal, which can be used by ECU. General sensors in EFI include load sensor which responds to air volume every cycle directly or indirectly, rotation speed sensor which responds to engine speed, crankshaft position sensor which responds 1st cylinder TDC; TPS, coolant temperature sensor, air charge temperature, barometric pressure sensor, oxygen sensor which responds to oxygen volume in exhaust and is used by closed control, manifold inlet pressure sensor.

(2)Electronic Control Unit (ECU)

The device is applied to receive and handle signals from sensors, instruct actuators to control engine.

(3)Actuators

Actuators are applied to do instructions of ECU and control fuel quantity. Main parts include power fuel pump and magnetic injectors.

• **Variables**

Control variables are applied to decide instructions for actuators by ECM, such as gasoline load, engine speed, coolant temperature, air temperature, air pressure etc. features. In general, one sensor informs one piece of information.

Tow more important variables in varies variables of engine (known as main control variables) are engine speed and engine load.

For engine, the load can be informed with air volume each cycle. When knowing engine speed, it is easy to know air volume every cycle according air volume every time unit. So generally use air charge as load.

ECU decides basic injecting quality and basic ignition BTDC by main control variables value and modify those values by other sub information such as coolant temperature, air temperature, so that accept last values about injecting quantity and ignition advance.

• INFORMATION FLOW OF EMS

Information flow of EMS is shown in Fig,4-2.

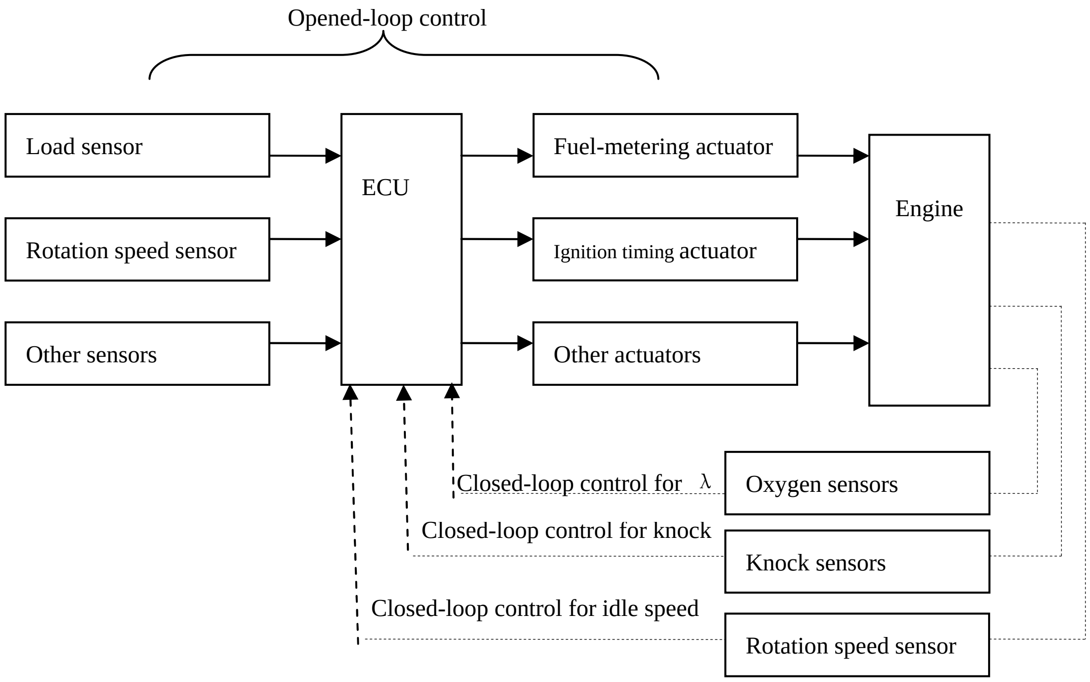


Fig. 4-2

ECU or ECM receives various information about engine responded by sensors to calculate and product instructions to actuators to make engine operate in perfect condition, which the power fuel pump and the injectors carry out fuel-metering injection, and the ignition coil and the distributor carry out ignition control.

Results of control is unknown by the way of the foregoing statement. Sometimes it is necessary to keep a feature in a range, for example, to make air/fuel close to theory air/fuel ratio 14.7 for satisfying emissions requirements or keep idle speed near 850r/minn or prevent knock on high-load condition. Closed-loop control is a way that forms close circuit in EMS. On the other hand, opened-loop control system is a control system that doesn' t form close circuit. The portion of short-line is closed-loop control, the portion of solid-line is opened-loop control (Fig 4-2).

It is necessary to indicate that it is impossible for electronic control system to change engine operating condition. Only external conditions, like man or engine operating environment, can change engine operating condition by changing engine main control variables. For example, engine operating condition is changed because throttle open degree is changed, which air volume charged is changed, or a vehicle is driven on upright from flat ground, engine speed will reduces though other conditions aren' t changed.

2. Principle

Electronic fuel injection system is a system that the central part is engine electronic control unit.

Sensors installed on positions of engine respond to various operating features and inform ECU.

According these information, engine－ECU controls injecting quantity, ignition advance accurately, based on preparing control program to make engine operate perfectly in various conditions.

When ignition switch ON, ECU or ECM is powered. As soon as the first crank rotation signal is checked, the fuel pump is powered and fuel press out with the pump. The fuel flows to fuel distribution pipe on engine through fuel filter and then the injectors installed on inlet manifold near intake ports, which inject fuel into cylinders. The fuel pressure, which is controlled with the pressure regulator on end of fuel rail, is 300KPa for both systems. Because pressure difference is constant with pressure regulator and section area of injector is constant too, so ECU or ECM can control injecting quantity every cycle by means of controlling the injector on-time. When injector opens, fogging fuel is injected into manifold which mixes with air and is inducted cylinder on inlet stroke to fire.

Driver can control throttle open degree with acceleration pedal to control air volume. ECU or ECM receives information such as air temperature, coolant temperature, air pressure, engine speed etc. and calculate out air volume and basic injecting period.

In a real run, after the basic injecting period is calculated, a modified value is prepared by information of feedback signal of oxygen sensor on exhaust system, instant load, battery voltage etc. ECU or ECM corrects the injecting quantity to actual injecting quality. ECU or ECM decides accurate injecting phase by preprogramming data, engine speed or crank position signals.

BOSCH M1.5.4 EMS adopts a pattern of sequential ignition with distributor.

DELPHI adopts a pattern of directive ignition without distributor. Drive circuit in ECU open or close ignition coil primary circuit, and supply ignition signals to 1-4 cylinders and 2-3 cylinders.

Both systems have self-diagnosis function. The service light in meter is lighted when troubles occurs.

Vehicle will operate in hirple pattern while parts in the system have trouble. There is a connector for tester.

BOSCH M1.5.4 is shown in Fig.4-3 a).

DELFHI system is shown in Fig 4-3 b).

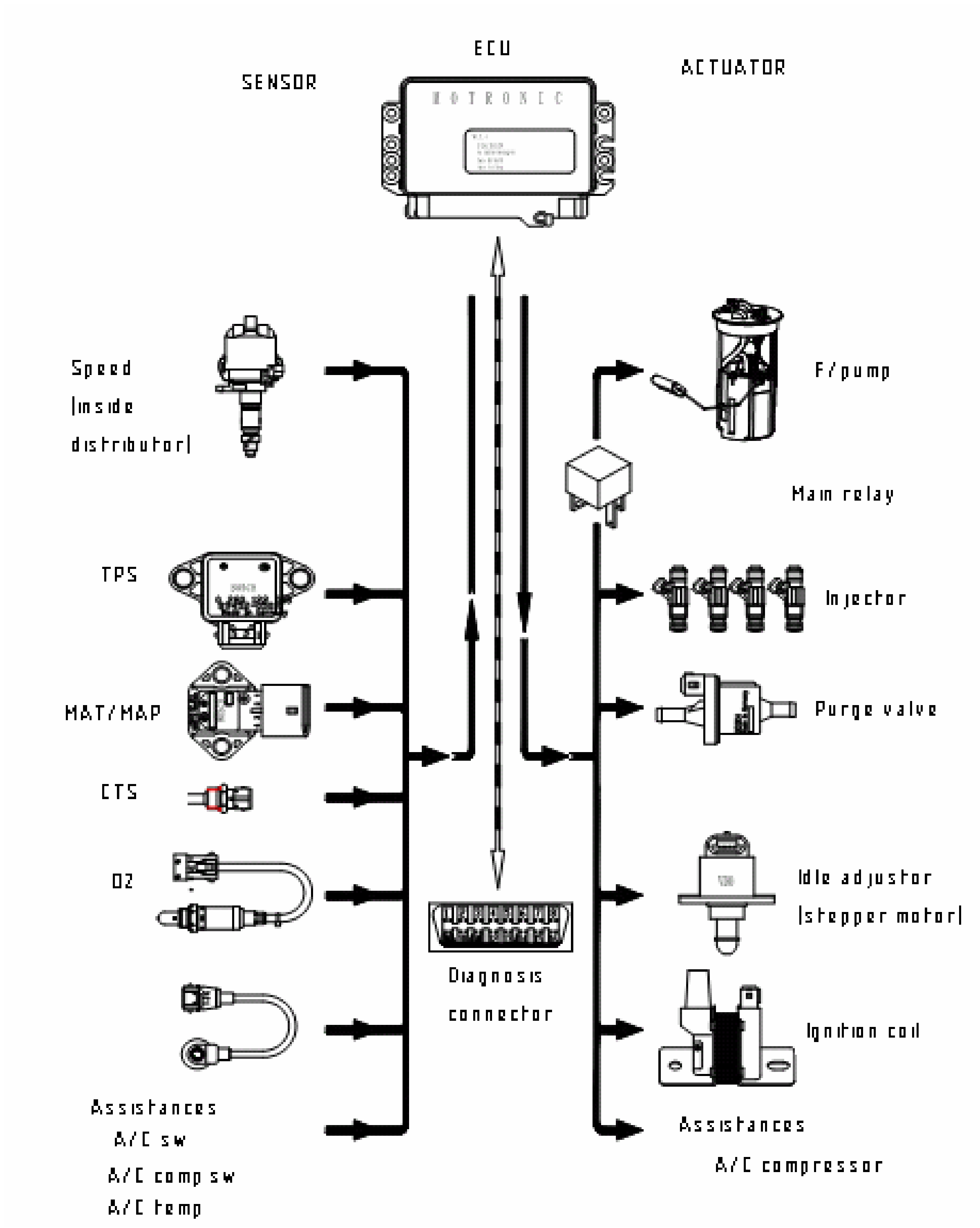

ECU
SENSOR
ACTUATOR
Speed
(inside
distributor)
TPS
MAT/MAP
CTS
O2
Assistances
A/C sw
A/C comp sw
A/C temp
Diagnosis
connector
F/pump
Main relay
Injector
Purge valve
Idle adjustor
(stepper motor)
Ignition coil
Assistances
A/C compressor

Fig. 4-3a)

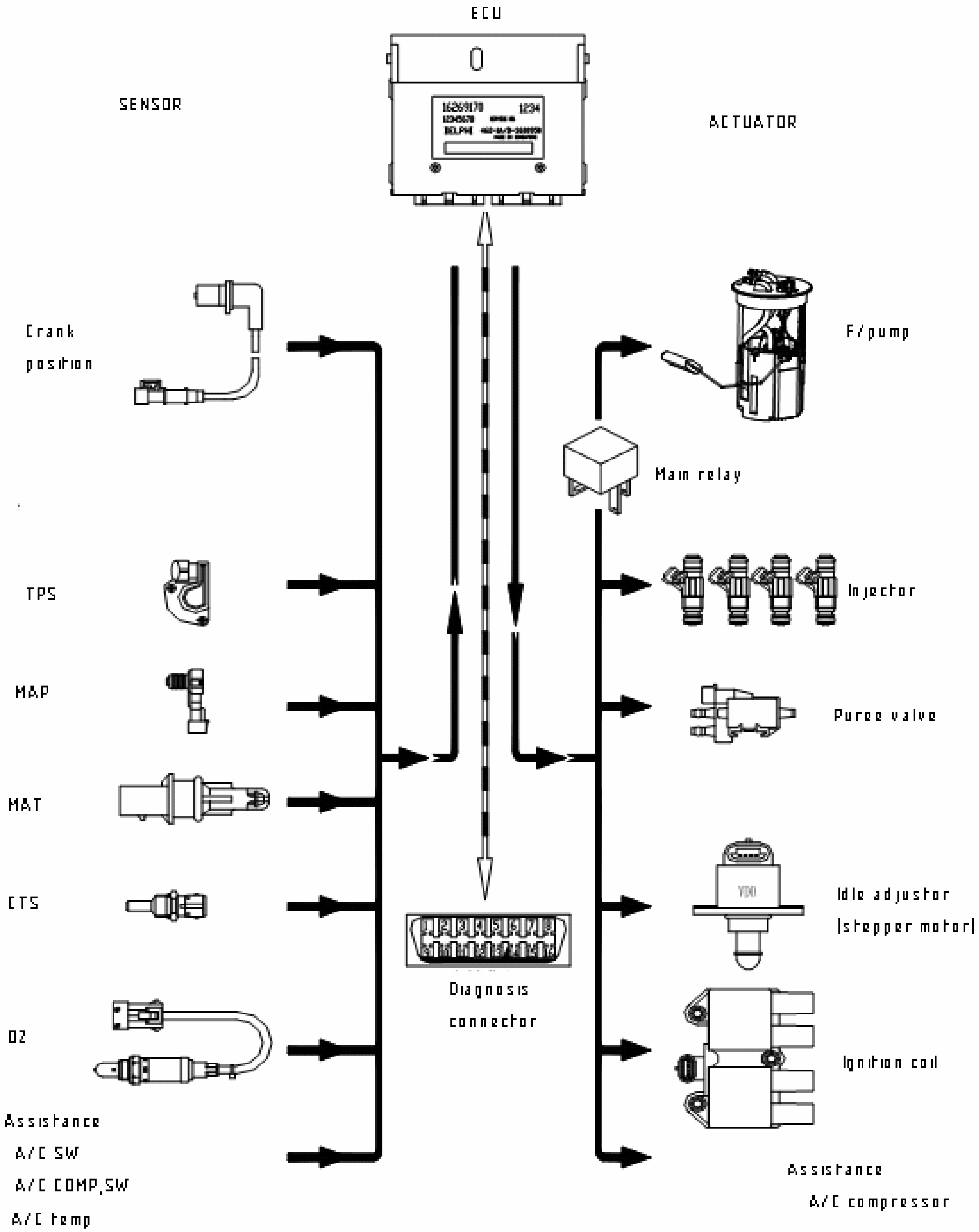
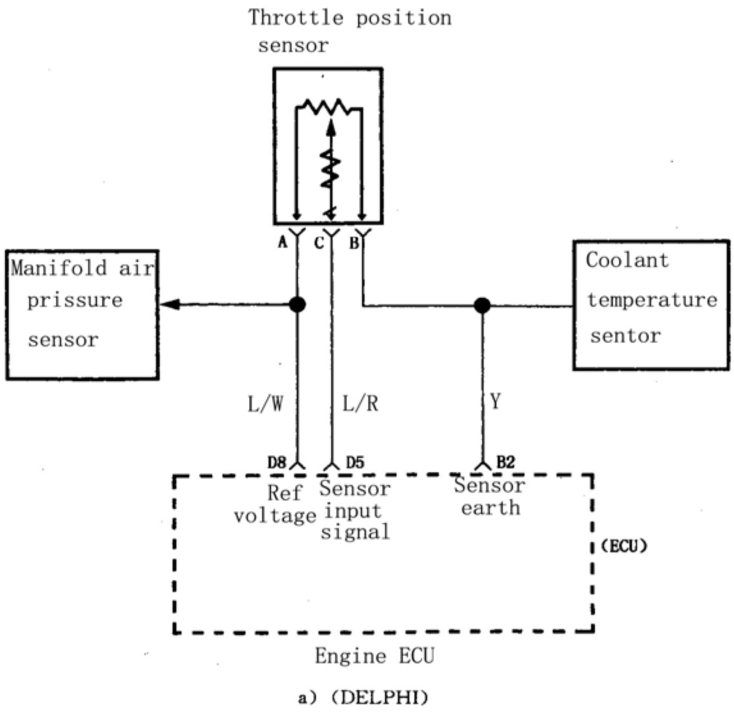


Fig 4-3b)

• SENSORS

1) Throttle position sensor

A sensor which is installed on throttle assembly coaxially (throttle assembly install on the front end of intake pipe), provide load, load range and acceleration information. Throttle position sensor monitors open degree of the throttle. The sensor is resistance type, which is powered with 5V by ECU or ECM and products voltage signal to ECU or ECM. The circuit diagram sees Fig. 4-4a).



a)

Throttle position sensor(TPS)
Manifold air pressure sensor
Coolant temperature sensor
Ref. Voltage
Sensor input signal
Sensor earth
Engine-ECU
LW
LR
Y

b)(BOSCH)

c)(DELPHI)

FIG.4-4

Item	BOSCH(Fig. 4-4b)
Resistance(1-3)	1.95～2.10KΩ
Resistance(2-3) Full close -full open	1.10～2.80KΩ

Item	BOSCH(Fig. 4-4a)	DELPHI(Fig. 4-4c)
Full close	0.1V～0.9V	0～0.25V
Full open	3.0V～4.8V	4～5V

2) Intake temperature/pressure sensor (Fig4-5a),Fig. 4-5b))

A sensor is installed on the intake manifold stable pressure chamber to offer engine load and temperature information, which is used to decided injecting quantity and ignition timing.

Fig 4-5a)

For BOSCH M1.5.4 , the voltage of 5V, which is supplied by ECU powers the sensor. Voltage between terminal 4 and ground is in a range of 3.8 – 4.2V. Voltage responded to pressure is 0.8 - 1.3V while idling,1.521 - 1.683V for 40kpa and 4.859～5.043V for 102kpa。Using ohmmeter to measure resistance between terminals 1,2, the value should be 2.2～2.7KΩ for 20℃ and 1.1～1.4KΩ for 30℃. If faulty, replace the sensor.

Fig 4-5b)

3)Knock sensor (Fig. 4-6)

Fig. 4-6

A sensor which is installed on inlet side of upper middle of 4 th cylinder, supplies information about knock to achieve closed-loop control of knock.

Using ohmmeter, measure resistance between terminals 1 and 2, which should be more than 10MΩ. Resistance between terminal 2 or terminal 3 and ground should be 0Ω.

CAUTION

Don't apply any gasket or lock parts when install knock sensor. Only bolt is permitted to fix the sensor, with tightening torque is 15-25N•m.

4) Coolant temperature sensor (Fig4-7a))

Fig 4-7a)

A device is installed on cycling water route of inlet manifol, offer coolant temperature information to correct the amount of fuel injection and ignition timing.

The sensor responds to engine coolant temperature and product voltage signal which is transmitted to ECU or ECM to control injecting quantity and ignition timing.

The sensor is thermo-resistance type. Its resistance decreases with temperature increasing.

For BOSCH M1.5.4, resistance between terminals 1, 2, sees Table 4-1.

Table 4-1

Coolant temperature (℃)	Resistance (Ω)	Coolant temperature (℃)	Resistance (Ω)
50	740～900	80	290～360
60	540～650	90	210～270
70	390～480	100	160～200

For DELPHI system, the principle diagram sees Fig.4-7b, resistance sees Table 4-1a)

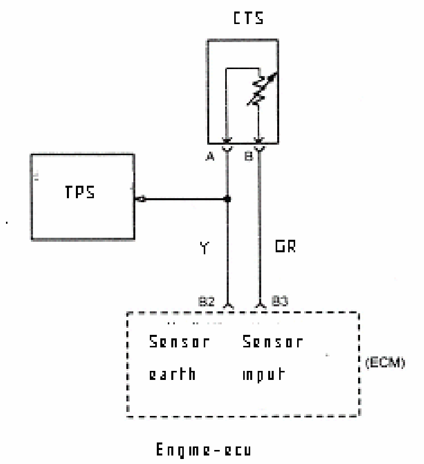


Fig.4-7b)

Table 4-1a)

Coolant temperature (℃)	Resistance (Ω)
20	180.3±2.3
80	337.9±2.6
100	180.3±2.3

5)Rotation speed sensor

Fig 4-8

For BOSCH M1.5.4 system, the sensor is a Hall sensor, which is installed in distributor to supply information about engine speed and crankshaft phase which is used as reference to timing for injection and ignition. When adjusting TDP of 1 st cylinder, scale on fly wheel should be on 0 degree, distributor should be located as shown in Fig.4-8, which low end of gas before hole in rotor should be along with the middle of HALL sensor. At this time, the ignition advance angle should be 6° - 7° .

6) Oxygen sensor

Fig4-9a)

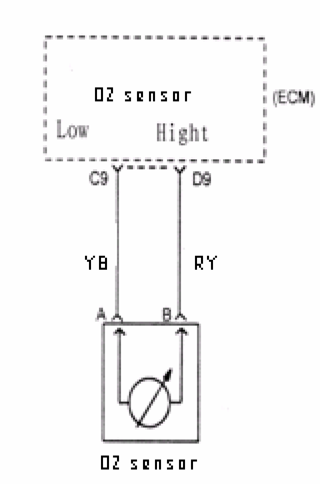


Fig 4-9b)

A sensor is installed on exhaust manifold to offer signals about mixture concentration to correct injecting quantity, which achieves closed-loop control of air/fuel ratio.

The sensor responds to oxygen concentration in exhaust and product voltage signal that is transmitted to ECU or ECM. With low air/fuel ratio, oxygen concentration in exhaust is high, which high voltage signal occurs.

For BOSCH M1.5.4 system, ECU power the sensor with voltage of 12-14V.

Inside resistance: ignition switch OFF. Disconnect oxygen sensor connector. Measure resistance between tow white leads, which the value should be 0.2Ω～20Ω (change with temperature)。

For DELPHI system, output voltage is 750mV (rich) - 150mV (lean) /400℃。

Crankshaft position sensor

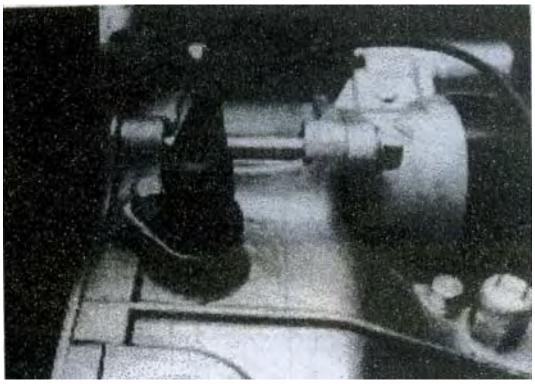
A sensor which is used by DELPH system is installed on the backside of cylinder head (Fig4-10a)), offer information of engine speed and crank phase signal which is used as reference for timing of injection and ignition.

The sensor responds to crank angle. A speed signal pan is fixed on fly wheel, with 60-2 teeth. When the pan rotates, pulse signals is provided on crankshaft position sensor and is transmitted to ECM to indicate crank angle and engine speed as shown in Fig 4-10b).

Output voltage range: ≥400V/60r/min

Coil resistance: 540Ω±50Ω/25℃±5℃

Gap between the sensor and signal pan: 0.5～1.75mm.



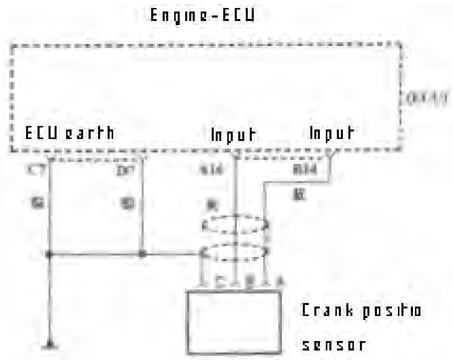


Fig. 4-10a)　　　　　　　　　　　Fig. 4-10b)　**Actuators**

1) Electronic fuel pump: Be installed in fuel tank, ECU controls fuel pump work with fuel pump relay, once engine stop working, electronic fuel pump stop automatically. The pump keeps fuel pressure on 300kPa

NOTICE
Not disassembly fuel pump to prevent from explosion for damaging seal part

2) Fuel injectors: Be installed on the fuel rail assembly (Fig4-11a), it inject fuel toward air passage by ECU control. The open period of needle in injector is controlled by means of magnetic field which is signaled by ECU or ECM, which decides injecting quantity. Fuel pressure keeps constant by pressure regulator when vacuum in inlet manifold changes.

Injector operation voltage: 12V

Coil resistance: 15.9Ω±0.35Ω (BOSCH M1.5.4 system)

12Ω±2Ω (DEHPHI system)

Fig 4-11a)

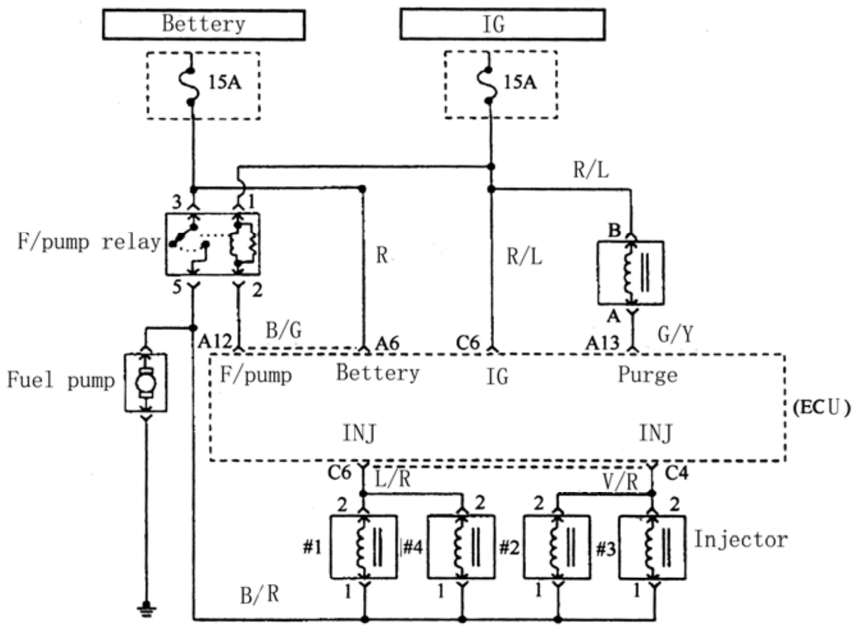


Fig. 4-11b)

3） Ignition coil

For BOSCH M1.5.4 system, ignition coil (Fig.4-12) primary circuit opens or closes, which is controlled by ECU. The bracket of ignition coil should ground reliably.

Fig.4-12a Fig 4-12b

For DELPHI MT20 system, ignition mechanism without distributor is used. Ignition signals to the dual ignition coils is driven by drive circuit in ECM. Four posts on the ignition is connected to sparks respectively, which one coil controls sparks of 1-4 cylinders and the other controls sparks on 2-3 cylinders. A voltage of 5V which ECU offers powers the primary circuit. When ECU cut off the power, (cut current of the primary circuit), high voltage is inducted on the secondary circuit , which is transmitted to sparks to fire as shown in Fig. 4-12b.

Primary windings resistance: 0.5Ω±0.05Ω

Inductive voltage in primary windings: 414V

Secondary windings resistance: 5100Ω±300Ω

Inductive voltage in secondary windings: 37.1kV.

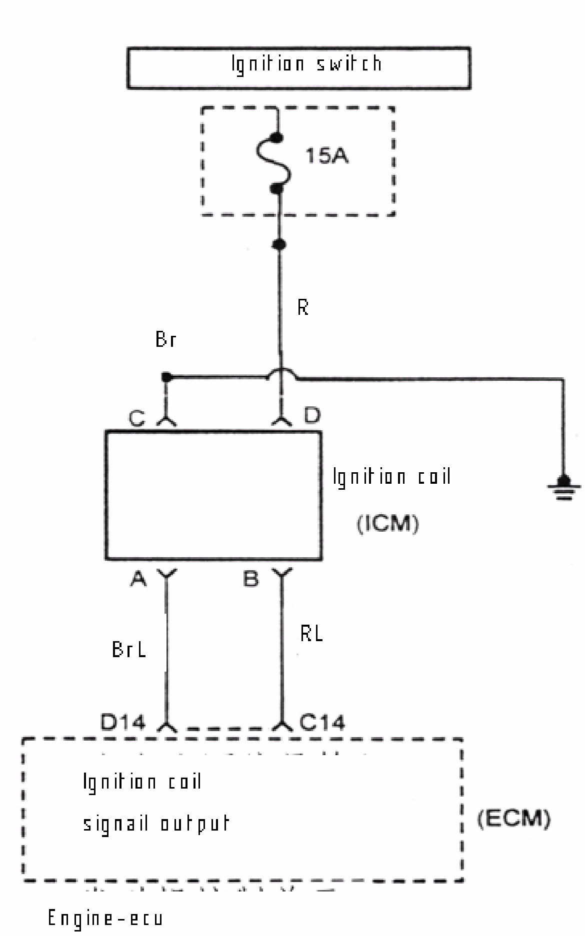


Fig. 4-12c

4） Idle adjuster (stepper motor): Be installed on the throttle body assembly. ECU controls its action and change section of by-pass path, and change the amount of by-pass air to control idle speed.

For DELPHI MT20 system (Fig.4-13a), resistance of coil is 17.7～20.0Ω

For BOSCH M1.5.4 system (Fig.4-13b, Fig. 4-13c),steps of step motor change in a range of 0～255 Steps.

Fig. 4-13a

Fig. 4-13b

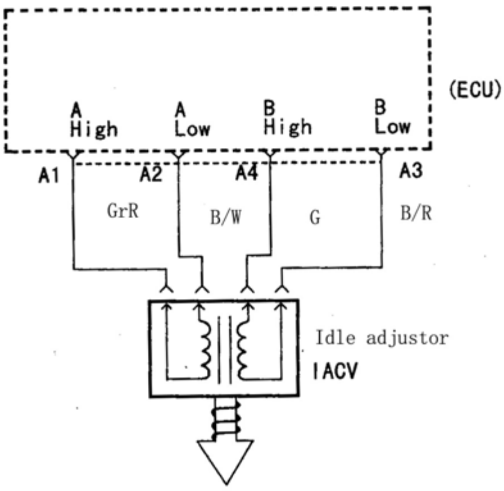


Fig. 4-13c

5） Canister purge valve（BOSCH system sees Fig4-14a），DELPHI system sees Fig4-14b)：Be installed on coupling portion of transmission and block. ECU control its opening degree to control the amount of clean air flow from canister to inlet manifold.

Fig. 4-14a)

Fig. 4-14b)

For DELPHI system, Coil resistance (Fig. 4-14c)： 21.8Ω～28.5Ω/20℃

Operation voltage: 8～16V

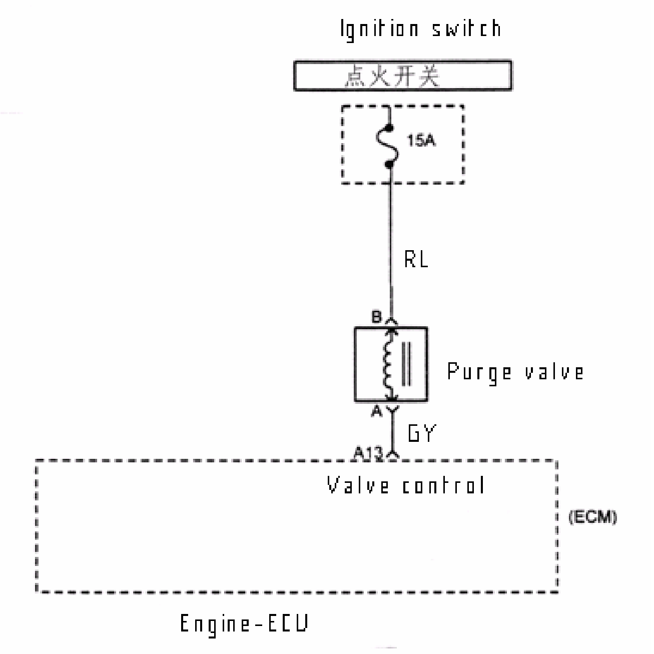


Fig.4-14c)

- **Electronic control unit (ECU)**

ECU (Fig4-15a), Fig.4-15b) sends order to actuators after analyzes the input signals of sensors.

Fig14-5a)

Fig14-15b)

4.1.3 Engine’s inspection

The following parts or components do not require engine removal to receive services (replacement, inspection or adjustment), see table 4-2:

Table 4-2

Part or Component	correction
①Spark Plug	Replace or inspect
②Distributor	Replace, inspect or adjust
③ Exhaust Manifold	Replace or inspect
④ Oil Filter	Replace
⑤ Oil Pressure Sensor	Replace

⑥ Valve Chamber Cover	Replace or inspect
⑦ Rocker Arm Shaft	Replace or inspect
⑧ Rocker Arm	Replace or inspect
⑨ Rocker Arm Spring	Replace or inspect
⑩ Camshaft	Replace or inspect
⑪Cylinder Head	Replace or inspect
⑫Radiator	Replace or inspect
⑬ Camshaft driven synchronization gear	Replace or inspect
⑭Crankshaft drive synchronization gear	Replace or inspection
⑮ Crankshaft drive timing gear	Replace
⑯ Timing chain	Replace
⑰ Oil basin and oil strainer	Replace or inspect
⑱ Throttle body	Replace
⑲ Inlet manifold	Replace
⑳ Alternator	Replace or inspect
21 Starter	Replace or inspect
22 Triangle belt for radiation fan.	Replace
23 Water pump	Replace, inspect or adjust
24 Chain pulley (crankshaft, generator, water pump)	Replace or inspect
25 Synchronization chain cover	Replace or inspect
26 Cooling hose	Replace or inspect
27 Oil pump、piston、piston ring and connecting rod	Replace or inspect Replace
28 Fuel rail, injectors	Replace
29 Fuel hose	Replace or inspect
30 PCV	Replace
31 Sensors	Replace

4.1.4 Engine Removal

- Remove service panel on floor panel

- Remove the guard stone under the engine;
- Unscrew the water drain plug of the radiator and cylinder , drain off coolant.
- Disconnect the negative wire from battery;
- Disconnect the positive wire from battery;
- Disconnect the connector of backup lamp switch;
- Remove flexible shaft of odometer from transmission.
- Remove water inlet and outlet hose of the heater.
- Disconnect the high tension cable from ignition coil.
- Disconnect lead from water temperature gauge.
- Disconnect sensors and actuators, the sensors and actuators see Table 4-2:

Table 4-2

No.	Item	Location	Mark
1	Intake temperature/ pressure sensor	Inlet manifold stable pressure chamber	
2	Throttle position sensor	Throttle assembly	
3	Knock sensor	Intake side of cylinder block	
4	Oxygen sensor	Exhaust manifold	
5	Water temperature gauge	Water route on inlet manifold	
6	Oil pressure switch	Outside of block	
7	Rotation speed sensor	Distributor	
8	Coolant temperature sensor	Inlet manifold	
9	Injectors	Fuel rail	
10	Crankshaft phase sensor	Backside of cylinder head	
11	Idle adjuster(step motor)	Throttle assembly	DELPHI(BOSCH)

- Disconnect positive wire of alternator;
- Remove A/C pipes from compressor according to A/C removal procedure
- Disconnect acceleration cable from throttle body assembly;
- Disconnect injectors.
- Disconnect crankcase bleed pipe from air filter;
- Disconnect intake hose from throttle body assembly;
- Disconnect inlet and return fuel hoses from fuel rail assembly;

Caution

Because pressure in the fuel pipes is very high whenever the engine stops, disconnect fuel hose after draining fuel, in order to avoid fuel from ejecting and danger happening. Remove on a place which is far from fire source.

- Disconnect water inlet and outlet hose from radiator.
- Disconnect cable of clutch from engine and clutch lever..
- Remove muffler from exhaust manifold and body frame.
- Remove drive shaft;
- Disconnect gear shift control cables from selector and shift arm on the transmission
- Disconnect leads (YB and +) from startor
- Disconnect battery negative lead from transmission case
- Remove the cover of radiator;
- Support engine and transmission;
- Remove connecting bracket of transmission from vehicle frame;
- Remove engine member assy. from vehicle frame;

Caution

Inspect all connectors around the engine again; be sure all parts are removed before removing the engine.

4.1.5 Service for engine electronic injection system

1. TROUBLESHOOTING FOR ENGINE OF EFI

Gasoline electronic control system is very complexity. Every trouble, such that part faulty, lead cut off, terminal separated or connect poor, lead to whole system malfunction. It is impossible for conventional tools to service. So a system, which is known as built-in self-diagnosis system is equipped in gasoline electronic control system. Tester specified for gasoline electronic control system is used for troubleshooting.

In principle, when a trouble related to engine electronic control fuel injection system is been inspecting, first you should act just like for conventional engine(without EFI), which check for mechanism trouble. Especially when service light in meter doesn’t light., engine should be inspected , just like the engine without ECM, on basic procedures.

CAUTION

Be sure that there are no trouble on mechanism portion before inspecting EFI, or in case of a single trouble which isn’t related to EFI, you inspect sensors, actuators and ECM, so that you spend a lot of time but cannot leave out the trouble.

- Without the testor
  1. Basic tools

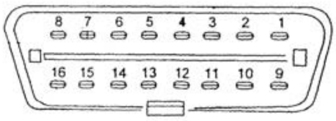


Fig. 4-16

multimeter, rotation speed meter, fuel pressure meter, vacuum meter.

2. read DTC (diagnosis trouble code)（FIG.4-16）

1) Connect the connector within vehicle to diagnosis connector as shown in left figure (DELPHI).

2) Service light in meter should flash.

3) Repair according to DTC.

4) There are several seconds between digits. If there are more than tow DTCs, the light flash for three times before next DTC is shown.

Table 4-4

DTC	Flashing number
	10
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9

- With the tester

  The tester is able to show input/output signals, test actuator to offer convenience for diagnosis. When ECM receives abnormal signals or referential voltage, it will remember DTC of the fault after judging, and transmit to the tester that is connected to diagnosis connector, which reads the DTC.

  Memory of DTCs is powered with battery, so DTCs continue to be kept even when ignition switch OFF. The memory will be eliminated when lead of battery or ECM connector is disconnected.

  Model of the tester used for DELPHI system is DL9000. Read User Manual of the tester carefully before using.

- **Points for Diagnosis**

The tester is used mainly to inspect faults of engine electronic control system. The time which is spent on troubleshooting will reduce greatly if the tester is used properly.

It is convenient to inspect most faults by means of the tester, but it is impossible to solve any trouble with the tester.

In general, it is not a single program to find causes of trouble symptoms. So a lot of knowledge is needed about engine electricity and mechanism. Diagnosis

troubleshooting should be done from simple reasons to difficult reasons, such that connectors connect poorly, fuse of EFI is blown, leakage occurs in inlet system. If the trouble continues after inspecting single reasons, use the tester.
The method will reduce diagnosis period of single troubles.

• **Conditions when using the tester**

(1) Battery voltage: >2V
(2) **Fuse is normal.**
(3) **Ground lead of engine is connected properly.**
(4) Ignition switch: ON
(5) Must drive for more than 4 min before reading DTCs for any trouble related regulation of air/fuel ratio.

• **Remove general troubles**

Basic tools: tester, multimeter.

Which is inspected below should be the trouble which symptoms continue after removing mechanism faults, which is related with EFI system.

Inspection for trouble symptoms

1) No starting

Means

(1) Does service light in meter light or not when Ignition switch ON ?

A. Not

- check fuse and ground lead;
- Test service light and its circuit with the tester;
- Inspect and repair the bulb and its circuit;
- Replace ECM.

B. light

- Connect the tester to diagnosis connector

(2) Can the tester communicates with the system or not?

A. Can't

- Check fuses and ground leads;
- Check ECM connector;
- Check the tester condition when it is used in a vehicle in normal condition;
- Replace ECM.

B. Can

- Remove troubles according to indications of the tester.

(3) Can sparks fire normally or not? –Ignition system check

A. Can't

- Check tension cables and sparks for coupling condition, such as damage or unproper;
- Check after replacing ignition coil;
- Check after replacing ECM

B. Can.

- Check connection of ignition coil and cylinders for order with tension cables;

(4) Fuel supply system check

1) Check order of inlet and outlet fuel pipelines;
2) Does fuel pump operate or not? – Listen to sound near fuel tank when engine operates

A. not
- Check fuel pump relay and its circuit;
- Check crankshaft position sensor (DELPHI system) and its connection;
- Replace ECM
- Check fuel pump circuit.

B. operate
- Check whether fuel pressure is more than 0.25Mpa;
- Check fuel filter, replace if necessary.
- Check inlet and outlet fuel pipeline;
- Check fuel pressure;
- Check control circuit of injectors;
- Clean injectors if necessary (once every 15000km).

2) Poor idling

No idling

Methods
- Check idling adjuster
- Check circuit and connectors of idling adjuster;

Engine racing during idling

Methods

1) idle control system check
- Check connector of idle control solenoids.
- Check that steps(50 – 159) of idling adjuster is in range and change in small level;
- Raise the steps for more 50 steps using the tester test actuator function of the tester. Check whether engine speed rises .

✧ If rises, stop engine, disconnect battery lead for 3 min, restart the engine.
✧ If no rise, replace throttle assembly.

2) Supply system check
- Check vacuum hoses for fuel regulator on fuel rail for connection and damage;
- Clean injectors if necessary.

Speed is too high in idling

Methods

It is normal condition if coolant temperature is lower than 68℃ or higher than 98℃. ECM raises idling speed to warm engine when coolant temperature is lower than 68℃. ECM raises idling speed to increase radiator capability when the temperature is higher than 98℃. Any trouble that is other than the tow conditions should be checked in following steps:
- Check that steps(40 – 159) of idling adjuster is in range and change in small level;

✧ If steps change in too small level, check vacuum hoses on inlet manifold for connection and plug.

•Reduce the adjuster for 30 steps with actuator test function of the tester. Check whether engine speed reduces too.

✧ If engine speed doesn't reduce, replace throttle assembly.

3) Poor acceleration
   - Check fuel filter for jam;
   - Check fuel pressure and injectors;
   - Reads on the tester is in normal range in idling or idling in high speed;
   - Gas of crankshaft position sensor is too big.

Inspection for intermittent malfunction

(1) Inspection for parts not related to electrical circuit
   - Must perform general service before doing the inspection. You can find trouble places usually with eyes, with shortened time. Inspection follows steps below:
   - Check ground places for ECU and be sure these places cleanly and steadily..
   - Check vacuum hoses and its coupling places to avoid leakage because of crack or disconnection;
   - Check port places of throttle assembly and air inlet to avoid leakage;
   - Check connection of tension cables for steady. Be sure that no cables have cracks or cut. Remove carbon on sparks
   - Be sure that all connectors and terminals is connected steadily and properly.

(2) Poor connection

Most interment malfunction is results of poor connection. Check following places in detail:
   - Be sure that harnesses connect and ground properly and steadily.
   - Be sure that terminals of sensors are contacted properly and steadily;
   - Be sure that connectors of sensors are not damage;
   - Be sure that sensors is connected to harness properly and steadily.

(3) Service light lights intermittently
   - If no DTC occurs, check following items:
   - ECM ground poorly
   - Relays operate poorly. Solenoids in ECM are driven or switched to lead interfere of electronic system;
   - Low voltage circuit in ECM and ignition system grounds poorly;
   - Circuit of service light or diagnosis connector short intermittently.

(4) Fuel system

Some intermittent malfunctions is results of poor fuel. If engine stops suddenly or other malfunctions occur, ask users for fill:

Is the vehicle filled at same station? Is the vehicle fill with cheap fuel? If the answer is YES, may there is problem of fuel quality. Check fuel tank to look for deposit, water and other impurity.

DTCs for BOSCH M1.5.4 system

Table 4-5

DTC	**Description**	**DTC**	**Description**
61	1st step motor solenoid	33	Over limit of engine speed
62	2nd step motor solenoid	34	ECM faulty
14	Throttle position sensor	35	Self-learn of air/fuel ratio-dtv

22	1st injector	36	Self-learn of air/fuel ratio-fra
23	2nd injector	37	Self-learn of air/fuel ratio-tra
24	3rd injector	17	Oxygen sensor
21	4th injector	18	Air temperature sensor
31	Correct value of air/fuel ratio	19	Coolant temperature sensor
15	Knock sensor	25	Purge valve
16	Air pressure sensor	38	Battery voltage
45	Service light		D9，C9
11	No trouble		C4，C6，C7，D7

DTCs for DELPHI system see Table 4-6

Table 4-6

DTC	Description	Related terminal
P0105	MAP sensor voltage too high	A7
P0105	MAP sengsor voltage too low	A7
P0110	Reading of MAT sensor too high	B4
P0110	Read of MAT sensor too low	B4
P0115	Reading of coolant temperature sensor too high	B3
P0115	Reading of coolant temperature sensor too low	B3
P0120	Voltage of TPS too high	D5
P0120	Voltage of TPS too low	D5
P0130	No changing voltage of oxygen sensor	D9,C9
P0170	Oxygen sensor too lean	D9,C9
P0170	Oxygen sensor too rich	D9,C9
P0200	Injector circuit	C4,C6,C7,D7
P0230	Fuel pump circuit ground	A12
P0230	Fuel pumps short to power line	A12
P0335	Crankshaft sensor circuit	B14,A16
P0351	Ignition coil A short to power line	C14
P0351	Ignition coil A ground	C14
P0351	Ignition coil A/B open	C14
P0352	Ignition coil B short to power line	D14
P0352	Ignition coil B ground	D14
P0443	Purge valve circuit	A13
P0505	Idling control system	A1,A2,A3,A4
P0560	System voltage too high	A6,C5
P1362	Immobilization faulty	B8
P1530	A/c cluch relay circuit	A15
P1532	Reading of A/c evaporator temperature sensor too low	D6
P1533	Reading of A/c evaporator temperature sensor too high	D6
P1604	EEPROM faulty	-
P1605	EPROM chip faulty	-
P1640	QDSM chip faulty	B10,B11,B12,B13

2.GENERAL SERVICE FLOW FOR EFI SYSTEM

General Troubleshooting diagnosis Flow

General troubleshooting diagnosis can follow steps blow

a. Ask user for trouble symptoms, on which conditions the trouble occurs, if the trouble has been removed before etc.
b. Check and judge if the trouble is related to mechanical parts. If it is , repair it.
c. Inspect whether the trouble symptom disappears. If it is, end service. If not, the trouble may be related with EFI system, which should be removed.
d. Read DTCs and locate troubles with DTCs.
e. Be sure that all troubles have been removed. If not, do again. If it is , end.

> CAUTION
> Information of troubles which self-diagnosis system offers only suggests which portions have trouble, but these can not indicate which trouble occurs clearly. For example, when ECU records one trouble that the sensor value is out of limits, it is not to say that the sensor has damaged, it is possible that it results of open or short circuit.

3. POINTS FOR SERVICE OF EFI SYSTEM

- **POINTS TO PAY ATTENTION TO WHEN SERVICING EFI SYSTEM**

At a time of use

（1）ECU or ECM is a précis device. Even if many malfunctions is related to ECU or ECM, the device by itself has very low malfunction ratio. So don’t deal with it or open its connector before you are sure that circuits and parts that is related to trouble isn’t problem.

（2）It often occurs that circuits open or connect poorly for electronic system. Besides some open /disconnected circuit, loosened connectors which can be found directly, poor circuits can be inspected with high-resistance multimeter to measure voltage and resistance. Forbid to check circuit for continuity by means of firing between spark plug and block. Because when spark occurs between spark plug and block instantly, a self-induction voltage may occur in solenoid to electronic elements.

（3）Don’t disconnect any electric device to prevent electronic elements from damage by inductive voltage when ignition switch ON.

（4）Must pay attention to following items when disconnecting battery:

①Must turn off ignition switch. If battery is disconnected while ignition switch ON, the dangerous degree for striking electronics elements is greater than condition 2, 3. Because in conditions 2, 3, battery is used as a big capacity to absorb self-inductive voltage in order to protect. There are no protection when battery is disconnected.

②Inspect DTC. If there are DTCs. Write the DTCs before disconnecting battery, because unsolidified information in ECU will disappear when battery is disconnected.

③Know the number of audio with thief-proof before battery is disconnected. Or it is difficult to unlock audio system self-lock and make effect to use.

（5）If engine operates poorly after battery is disconnected, comparing to engine operation before, not replace any part promptly. Because memory of learn-correction will disappear when battery is disconnected. ECU control by data stored in ROM, which is different from actual learn-correction control. In this case, engine operates for a while to build in learn-correction memory by itself, poor drive operation disappear automatically.

（6）Distinguish positive and negative poles when battery is connected. Fix coupling part properly and steadily. Otherwise, bad effect to electronic device will product.

（7）Keep elements and connectors of electrical system from water when washing, especially ECU or ECM to prevent from short circuit, leakage current, rusty,

（8）Disconnect ECU or ECM from battery while repairing with arc welding, Must disconnect ECU or ECM while operation of welding is close to it.

（9）Pay attention to learn-correction when ECU or ECM is serviced. For instance, while you remove or install PROM., test inside features using multimeter, a metal strap wrap hand on one end and ground on other end to shield learn-correction.

（10）Don't connect or disconnect any device in case that circuit construction isn't known clearly, to avoid malfunction by man.

- Points for use and service of EFI system

1. Leakage in inlet system have more effect to engine with EFI than that with carburetion. Because leakage air isn't measured for EFI engine, a great effect will generate to air/fuel ratio. So at any time that engine operates poorly, check throttle assembly, canister air valve, idling adjuster and exhaust gas recycling for looseness, and air hoses and its ports for leakage. Besides these, check oil scale and oil-filled lid for seal.
2. Because fuel pressure continues after engine stops, so prevent fuel from spraying when you remove fuel lines to lead to danger. Put a pan below before fuel couplings is removed, and lead fuel to the pan with a towel.
3. Seal-washer on fuel lines can only be used for one time. Don't use seal-washer on fuel lines repeatedly..
4. Don't damage new o-rings to make effect to injector seal while installing injectors. Lubricate o-rings with gasoline and it is forbidden to lubricate with oil or gear oil.
5. In general condition, Do not operate the adjusting screw on throttle assembly. Because power performance of engine will decrease and fuel consumption will increase if the screw is adjusted improperly.
6. The performance of coolant temperature sensor may change after the sensor have been used for long period. The coolant temperature signal will be inaccurate, which infect fuel injection, ignition timing and fuel pump. The change of the feature isn't distinguished with self-diagnosis system. So when engine operates poorly, such as no starting, idling poor, high fuel consumption, and no DTC of coolant temperature occurs with self-diagnosis system, check coolant temperature sensor.
7. Do not drop oxygen sensor or collide it with other things when the sensor is checked. Do not cool the sensor with water. Apply specified adhibition-proof glue to the sensor on case of replacing it to prevent removal from the difficulty next.

- Points for use and service (BOSCH m1.5.4 system)

1. Do not touch the ignition coil and the tension cables with hand when the engine is started and operates to prevent from being injured with high voltage.
2. It is best to use insulation rubber to clip tension cables when you do high-voltage firing. It is easy to produce electric strike if tension cables is touched with hand directly. Person will feel uncomfortable even though it do not injure person. The person of operation often throw away the tension cables as soon as electric strike generates to

make the high-voltage circuit opened, which the highest voltage generates when the secondary circuit opens. The highest voltage is 3-4 times higher than ignition voltage, which damages ignition high voltage circuit.

Method which avoid electric strike is that the tension cable is inserted to an assistance spark plug, and then the spark plug is grounded , last observe spark condition between the electric poles when high voltage firing is done.

3. When each cylinder operation is checked with cutting off fire in order, ground the tension cables of which cylinder is cut off, with same cause as 2.
4. Ignition timing has great effect on the engine operation. So do not forget to check ignition timing when the engine operates badly, or after engine overhaul.

- Referent data for engine diagnosis

Purpose: supply standard data during engine troubleshooting（Table4-7、Table4-8）。

Conditions: after engine warms and controlled with closed-loop pattern,, engine operates without any load such as air condition, lights.

BOSCH M1.5.4 system

Table 4-7

Items	Operation condition or unit	Standard value at idling
Real engine speed	r/min	850±50
Projected speed	r/min	850
Battery voltage	V	12~14
Fuel pump relay	Work or not	Work
TPS signal	Open degree %	0
MAP	hPa	350～650
Inlet air volum	kg/h	6~12
Coolant temperature sensor	℃	80~90
Load	ms	1.8~3.0
MAT	℃	20~70
Air/fuel ratio control integrator xfr		-5% ~ 5%
Air/fuel ratio control self-adapted value xfru		0.95~1.05
Air/fuel ratio control self-adapted value xtru		120~140
Air/fuel ratio control self-adapted value zdtv		128
Injector on-time	ms	4~7
Spark advance angle	degree	5～10
Oxygen sensor	V	0.2~0.8
Closed-loop mode	Opened/closed	closed
Idling control	Work or not	Work
Idling adjustment	Steps	60~100
Duty ratio of purging		0

Note: the table is for DA465Q-1A series engine

.DELPHI MT20 system Table 4-8

Table 4-8

Items	Operation conditions or unit	Standard value at idling
Real engine speed	rpm	880±50
Projected speed	rpm	880
Battery voltage	V	10.8~14.1
Fuel pump relay	Work or not	Work
TPS signal	Open degree %	0
TPS signal	V	0.50~0.82
MAP sensor	kPa$\times 10^2$	0.28~0.38
MAP sensor	V	0.65~1.32
Coolant temperature sensor	℃	85~95
Coolant temperature sensor	V	0~5
MAT sensor	℃	0~110
MAT sensor	V	0~5
A/C switch	Work or not	Not work
A/C load	Work or not	Not work
Injecting period	ms	1.0~2.0
Mode of removing remained fuel	Work or not	Not work
Ignition advance angle	(°)	7～13
Oxygen sensor	mV	100~950
Control loop circuit mode	Opened or closed	closed
Idling control	Work or not	Work
Idling control	steps	20~60

Note: the table is for DA462-1A、DA465Q、DA465Q-1A series engine

4.2 DA465Q-16MC SERIES ENGINE

4.2.1 GENERAL DESCRIPTION

This series engine is in-line 4-cylinders, water-cooled, 4-stroke cycle MPI gasoline unit with valve mechanism arranged for “V”-type valve configuration and single overhead camshaft, which is installed in the cylinder head and driven by the crankshaft with timing chain. With compare to general model, no valve lifter is available in the model, so that valves is driven in more directive method and open or close more promptly..

• **Engine** Characteristics

• The inlet and outlet valves in the head is arrayed in V type with intake ports and exhaust ports in configuration of Orthogonal flowing pattern, so that efficiency of charge and exhaust is high.

• Combustion chamber shape is multi-sphere, with low burning consumption and high power performance.

• Rocker arm shaft of camshaft is supported with the head, with more compact constriction with the head, so that this reduces noise from inlet system and quantity of parts in induction system, which make engine more compact.

• Timing chain driving camshaft has characteristics of light weight and low operating noise.

• The engine block is made from DAZT-02 type of iron-casting and has deep side rims for high rigidity.

• The crankshaft are constructed of one-piece 40Cr-steel of forged alloy steel , which is supported by five bearings, with low vibration.

• Cycling heat water flows through inlet hose to heat inlet manifold, which help to vapor gasoline, so that mixture gas distribution is kept equably to have high fuel consumption efficiency

Leakage Cycling System

Leakage pipeline is located inside the block. The leakage flows to the head through crankcase, and fuel is separated from the air with separation plate in the head before the leakage is out.

4.2.2 EFI SYSTEM

1. CONSTRUCTION PARTS

Engine electronic control system is separated into hardware and software. The hardware includes sensors, control unit, actuators. The software includes three portions: control programs, data model and decided features. DA465Q-16MC type of engine is developed by DONGAN POWER limited company and USA DELPHI company, which has features of grouping ignition, sequential injection, closed-loop idling control, λ closed-loop control and fuel vapor emission automatic control.

(1) Sensors

Sensor is a device that responds to a physical stimulus (heat, light, sound, pressure, motion, flow, and so on), and produces a corresponding electrical signal, which can be used by ECU. General sensors in EFI include load sensor which responds to air volume every cycle directly or indirectly, rotation speed sensor which responds to engine speed, cam position sensor which responds 1st and 4th cylinder TDC;. TPS, coolant temperature sensor, inlet air temperature sensor, barometric pressure sensor, oxygen sensor which responds to oxygen volume in exhaust and is used by closed-loop control.

(2) Electronic Control Unit (ECU)

The device is applied to receive and handle signals from sensors, instruct actuators to control engine.

(3) Actuators

Actuators are applied to do instructions of ECU and control fuel quantity. Main parts include power fuel pump and magnetic injectors.

2. VARIABLES

Control variables are applied to decide instructions for actuators by ECU, such as engine load, engine speed, coolant temperature, air temperature, air pressure etc. Generally, one sensor informs one piece of information.

Tow more important variables in various variables of engine (known as main control variables) are engine speed and engine load.

The engine load can be computed with air volume each cycle. Known engine speed, it is easy to know air volume every cycle according air volume every time unit. So generally employ air charge volume for load.

ECU decides basic injecting quality and basic ignition advance by main control variables values and modify those values by other sub information such as coolant temperature, air temperature, so that accept last values about injecting quantity and ignition advance, which ECU instructs actuators with and controls engine.

3. INFORMATION FLOW OF EMS

Information flow of EMS is shown in Fig,4-17.

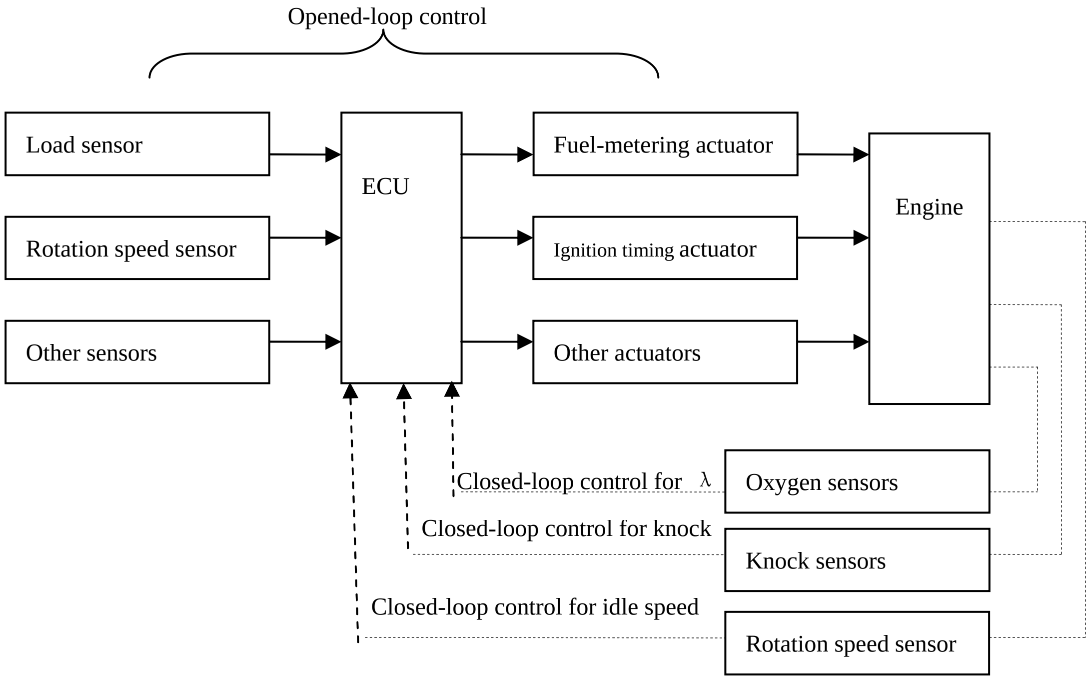


Fig. 4-17

ECU or ECM receives various information about engine responded by sensors to calculate and product instructions for actuators to make engine operate in perfect condition.

Result of control is unknown by the way of the foregoing statement. Sometime it is necessary to make a feature in a range, for example, to make air/fuel be close to theory air/fuel ratio 14.7 for satisfying emissions requirements or keep idle speed near 850r/minn or keep out knock in high-load condition. Closed-loop control is a control that form close circuit in EMS. On the other hand,\

opened-loop control system is a control system that doesn't form close circuit. The portion of point-line is closed-loop control; the portion of line is opened-loop control.

It is necessary to indicate that it is impossible for electronic control system to change engine operating condition. Only external conditions, like man or engine operating environment, can change operating condition by changing engine main control variables. For example, engine operating condition is changed because throttle open degree is changed to change air volume, or a vehicle is driven on upright from flat ground, which engine speed decreases though other conditions aren't changed.

DELPHI MPI system (Fig. 4-18)

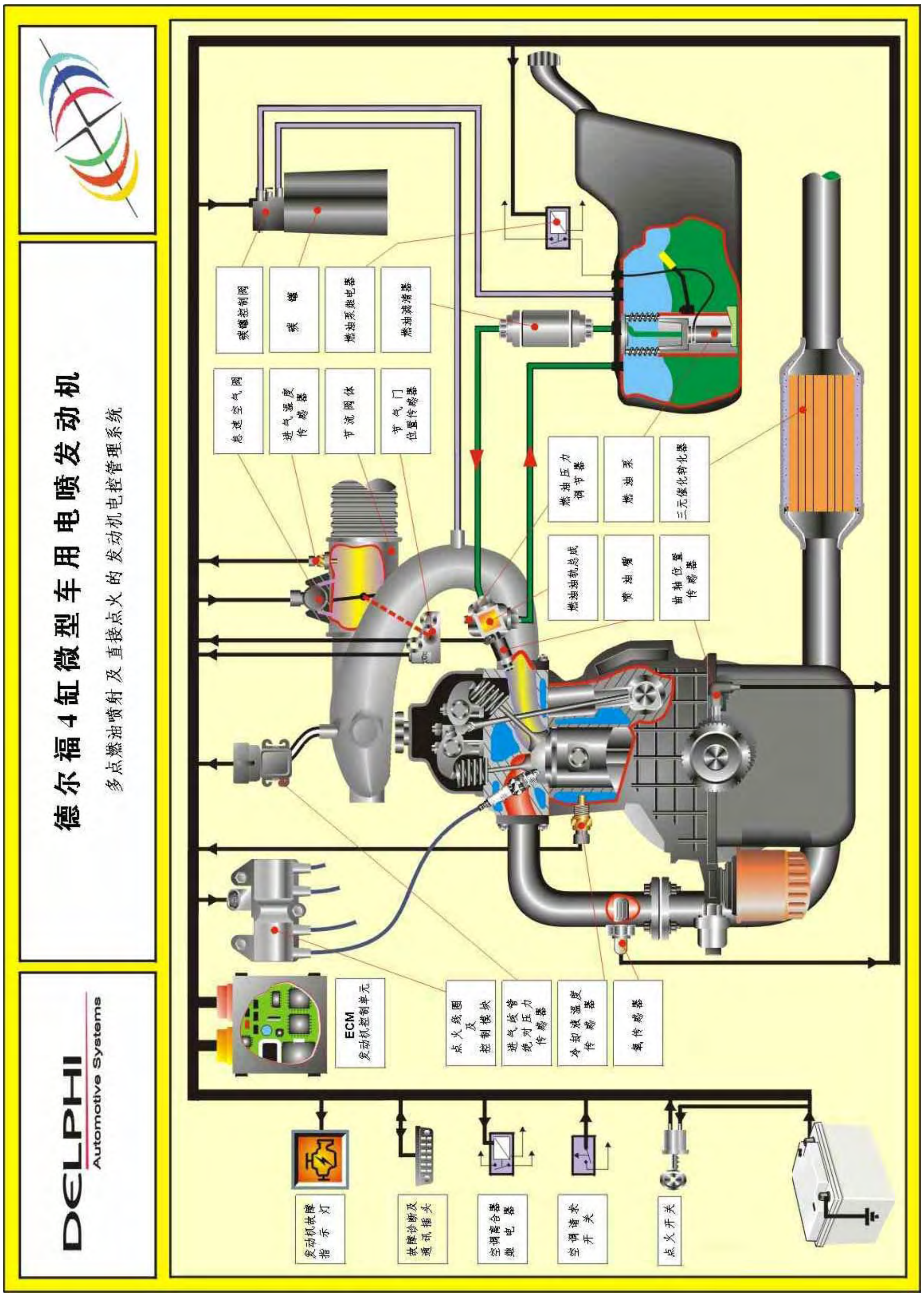


Fig. 4-18

DELPHI 4-cylinder EFI engine for mini van.

Engine electronic control manage system of multi-injection, directive ignition.

Engine service light

Diagnosis and communication connnector

A/C clutch relay

A/C require switch

Ignition switch

Engine-ECU

Ignition coil and control module

Manifold air pressure sensor

Coolant temperature sensor

Oxygen sensor

Idle control valve

Manifold air temperature sensor

Throttle body

Throttle position sensor

Fuel rail assembly

Injector

Crank position sensor

Fuel pressure regulator

Fuel pump

Three-way catalytic converter

Purge valve

Canister

Fuel pump relay

Fuel filter

4. Sensors and Actuators

• Sensors

1) Throttle position sensor(Fig.4-19):

A sensor is installed on throttle assembly coaxially. The sensor circuit sees Fig.4-20.

The sensor responds to open degree of throttle and produces voltage signal to ECU, with resistor in the sensor, which is power with 5V by ECU.

Fig. 4-19

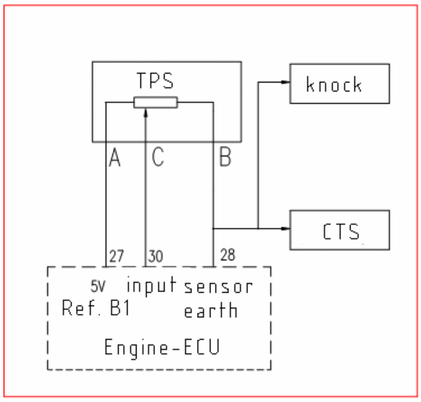


Fig4-20

Item	DELPHI(see Fig. 4-4C)
Full close	0～0.25V
Full open	0～5V

2) Intake temperature/pressure sensor (Fig4-21)

A device which is installed on the intake manifold stable pressure chamber to offer engine load.

The voltage of 5V, which is supplied by ECU power the sensor. The sensor responds to manifold pressure under varies load and engine speed and produces voltage signal to ECU.

Fig.4-21

3) Crankshaft position sensor

A sensor which is installed on housing of transmission, offers information of engine speed and crank phase signal which is used as reference for timing of injection and ignition.

The sensor responds to crank angle. A speed signal pan is fixed on fly wheel, with 60-2 teeth. When the pan rotates, pulse signals generate on crankshaft position sensor and is transmitted to ECM to indicate crank angle and engine speed as shown in Fig 4-23.

Fig.4-22

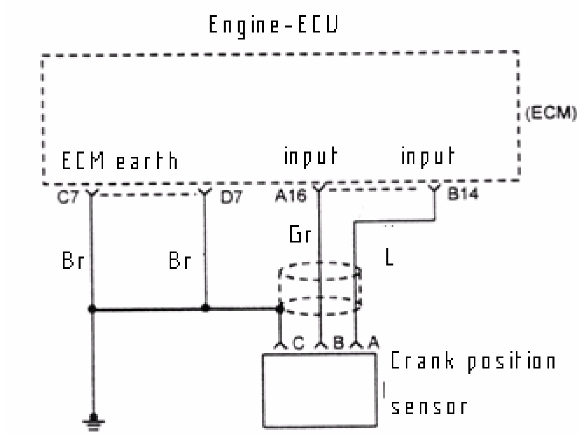


Fig. 4-23

Output voltage range:. ≥400V/60r/min

Coil resistance: 540Ω±50Ω/25℃±5℃

Gap between the sensor and signal pan: 0.5～1.75mm.

4) **Coolant temperature sensor** (Fig. 4-24)

A device which is installed on cycling water route of inlet manifold, offers coolant temperature information to correct the amount of fuel injection and ignition timing.

The sensor responds to engine coolant temperature and produces voltage signal which is transmitted to ECM to control injecting quantity and ignition timing.

Fig. 4-24

The sensor is thermo-resistance type. Its resistance reduces with temperature increasing (Fig.4-25).

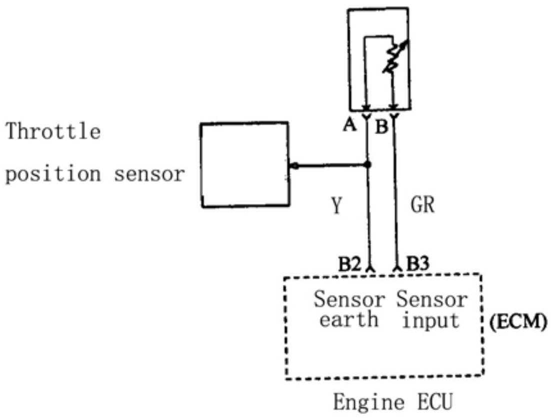


Fig.4-25

Coolant temperature （℃）	Resistance（Ω）
20	3555±3.6
80	337.9±2.6
100	180.3±2.3

5) **Oxygen sensor** (Fig. 4-26)

Fig. 4-26

A device which is installed on exhaust manifold, offers signal about mixture concentration to correct injecting quantity, which achieves closed-loop control of air/fuel ratio (Fig 4-26).

The sensor responds to oxygen concentration in exhaust and produces voltage signal that is transmitted to E ECM. With low air/fuel ratio, oxygen concentration in exhaust is high, which high voltage signal occurs (Fig.4-27).

Output voltage is 750mV（rich） - 150mV（lean）/400℃。

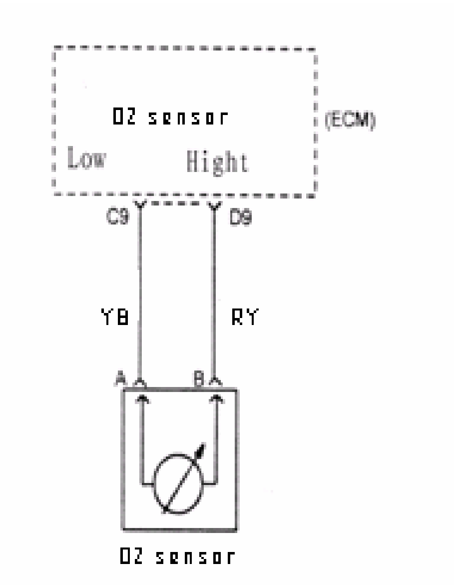


Fig. 4-27

6) Cam position sensor(Fig. 4-28, Fig. 4-29)

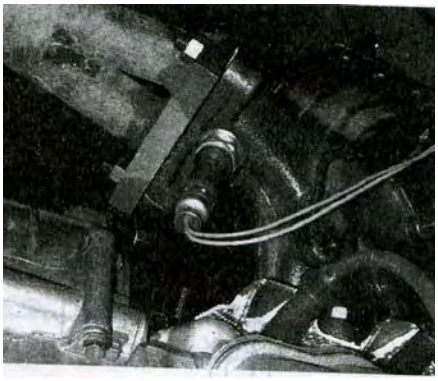


Fig. 4-28

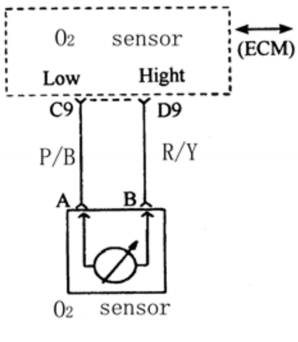


Fig. 4-29

- Actuators

1) Electronic fuel pump: Be installed in fuel tank, ECU controls fuel pump work with fuel pump relay, As soon as engine stops, electronic fuel pump stops automatically. The pump keeps fuel pressure at 300kPa

。

NOTICE Not disassembly fuel pump to prevent from explosion for damaging seal part

2）Fuel injectors (Fig.4-30): Be installed on the fuel rail assembly, it inject fuel toward air passage by ECU control. The open period of needle in injector is controlled by means of magnetic field which is signaled by ECU or ECM, which decides injecting quantity. Fuel pressure keeps constant by pressure regulator when vacuum in inlet manifold changes.

Injector operation voltage: 12V

Coil resistance: 12Ω±2Ω

Fig. 4-30

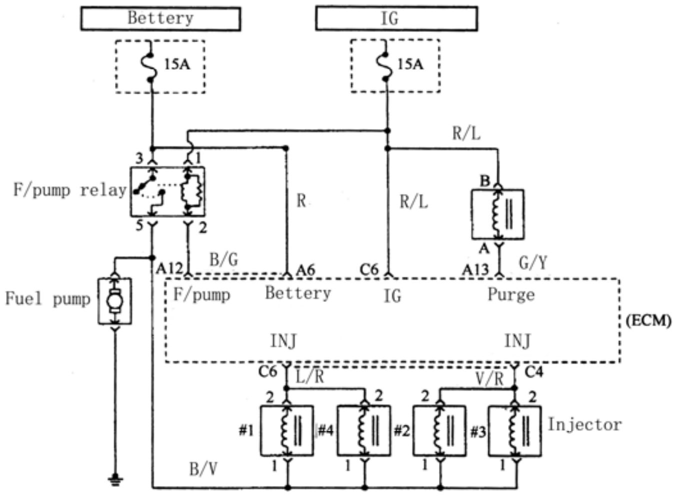


Fig.4-31

3）Ignition coil(Fig. 4-32)

The ignition system adopts a technology which doesn’t use distributor. Ignition signals to the dual ignition coils is driven by drive circuit in ECM. Four posts on the ignition coil is connected to sparks respectively, which one coil controls sparks of 1-4 cylinders and the other controls sparks on 2-3 cylinders. A voltage of 5V which ECU powers the primary circuit. When ECU cut off the power, (cut current of the primary circuit), high voltage is inducted on the secondary circuit , which is transmitted to sparks to fire as shown in Fig. 4-33.

Primary windings resistance: 0.5Ω±0.05Ω

Inductive voltage in primary windings: 414V

Secondary windings resistance: 5100Ω±300Ω

Inductive voltage in secondary windings: 37.1kV。

Fig. 4-32

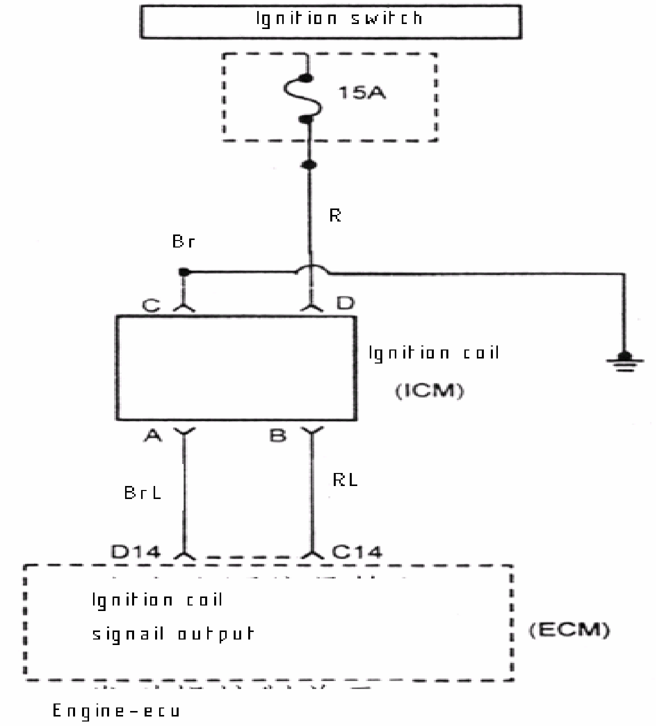


Fig. 4-33

• Idle adjuster (stepper motor) (Fig.4-34、Fig.4-35)

A device which is installed on the throttle body assembly. ECU controls its operation to change section of by-pass path, which change the amount of by-pass air to control idle speed.

Steps of stepper motor change in a range of 0～255 Steps.

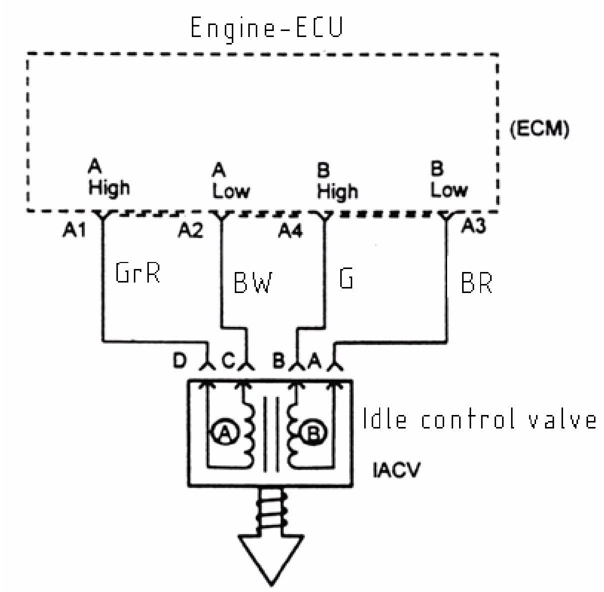


Fig.4-34

Fig.4-35

· purge valve (Fig.4-36, Fig.4-37)

A device is installed on back of manifold. ECU control its opening degree to control the amount of clean air flow from canister to inlet manifold. Purge valve is a open/close valve and is applied to take fuel gas in canister into manifold.

Coil resistance: 21.8Ω～28.5Ω/20℃

Operation voltage: 8～16V

Fig. 4-36

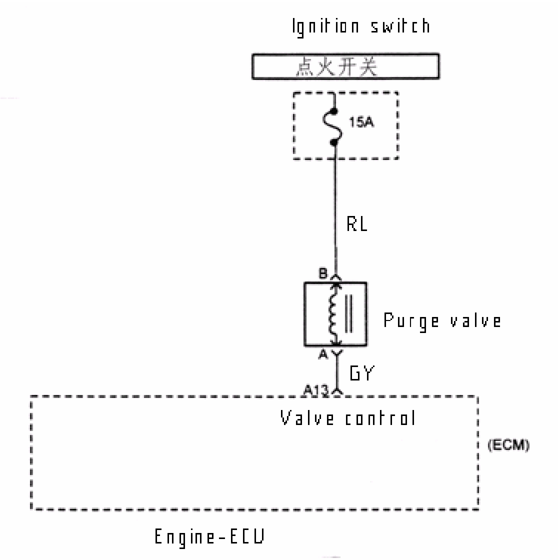


Fig. 4-37

- . ELECTRONIC CONTROL UNIT (ECU)

ECU ,which is installed on the body, sends instructions to actuators after analyzes the input signals of sensors.

CAUTION Which the device is installed on should be water-proof and low temperature

Fig14-38

5. Troubleshooting

Gasoline electronic control system is very complex system. Every trouble, such that part faulty, lead cut off, terminal separated or connect poor, lead to whole system malfunction. It is impossible for conventional tools to service. So a system, which is known as built-in self-diagnosis system is equipped in gasoline electronic control system. Tester specified for gasoline electronic control system is used for troubleshooting.

In principle, when a trouble related to engine electronic control fuel injection system has been inspected, first you should act just like for conventional engine(without EFI), which check for mechanism trouble. Especially when service light in meter doesn't light. The engine should be inspected , just like the engine without ECM, with basic procedures.

> CAUTION
> Be sure that there are no trouble on mechanism portion before inspecting EFI, or in case of a single trouble which isn't related to EFI, you inspect sensors, actuators and ECM, so that you spend a lot of time but cannot leave out the trouble.

· General Troubleshooting diagnosis Flow

General troubleshooting diagnosis can follow steps blow

a. Ask user for trouble symptoms , which conditions the trouble occurs on, if the trouble has been removed before etc.
b. Check and judge if the trouble is related to mechanical parts. If it is , repair it.
c. Inspect whether the trouble symptom disappears. If it is, end service. If not, the trouble may be related with EFI system, which should be removed.
d. Read DTCs and locate troubles with DTCs.
e. Be sure that all troubles have been removed. If not , do again. If it is , end.

> CAUTION
> Information of troubles which self-diagnosis system offers only suggests which portion have trouble, but these can not indicate which trouble occurs clearly. For example, when ECU records one trouble that the sensor value is out of limits, it is not to say that the sensor has damaged, it is possible that it results of open or short circuit.

● Points for use and service of EFI system

· Leakage in inlet system has more effect to engine with EFI than that with carburetion. Because leakage air isn't measured for EFI engine, a great effect will generate to air/fuel ratio. So at any time that engine operates poorly, check throttle assembly, canister air valve, idling adjuster and exhaust gas recycling for looseness, and air hoses and its ports for leakage. Besides these, check oil scale and oil-filled lid for seal.
· Because fuel pressure continues after engine stops, so prevent fuel from spraying when you remove fuel lines to lead to danger. Put a pan below before fuel couplings is removed, and lead fuel to the pan with a towel.
· Seal-washer on fuel lines can only be used for one time. Don't use seal-washer on fuel lines repeatedly..
· Don't damage new o-rings to damage injector seal while installing injectors. Lubricate o-rings with gasoline and it is forbidden to lubricate it with oil or gear oil.
· In general condition, Do not operate the adjusting screw on throttle assembly. Because power performance of engine will decrease and fuel consumption will increase if the screw is adjusted improperly.
· The performance of coolant temperature sensor may change after the sensor have been used for long period. The coolant temperature signal will be inaccurate, which infect fuel injection, ignition timing and fuel pump.

The change of the feature isn't distinguished with self-diagnosis system. So when engine operates poorly, such as no starting, idling poor, high fuel consumption, and no DTC of coolant temperature occurs with self-diagnosis system, check coolant temperature sensor.

- Do not drop oxygen sensor or collide it with other things when the sensor is checked. Do not cool the sensor with water. Apply specified adhibition-proof glue to the sensor on case of replacing to avoid difficult removal at next time.

- Points for use and service of ignition system.
- Do not touch the ignition coil and the tension cables with hand when the engine is started and operates to prevent from being injured with high voltage.
- It is best to use insulation rubber to clip tension cables when you do high-voltage firing. It is easy to produce electric strike if the tension cables is touched with hand directly. Person will feel uncomfortable even though it do not injure person. The person of operation often throw away the tension cables as soon as electric strike generates to make the high-voltage circuit opened, which the highest voltage generates when the secondary circuit opens. The highest voltage is 3-4 times higher than ignition voltage, which damages ignition high voltage circuit.
  The other method that avoid electric strike is that the tension cables are inserted to an assistance spark plug, and then the spark plug is grounded , last observe spark condition between the electric poles when high voltage firing is done.
- When each cylinder spark condition is checked with cutting off fire in order, ground the tension cables of which cylinder is cut off, with same cause as 2.
- Ignition timing has great effect on the engine operation. So do not forget to check ignition timing when the engine operates badly, or after engine overhaul.

- Points for three-way catalytic converter on use and service
- Do not use gasoline with lead. After the gasoline fires, lead should shied surface of the catalyzer while it is emitted with exhaust to make it lost catalytic function. Besides, this should make oxygen sensor "lead-poisoning" to lost its function.
- Avoid to lead unfired mixed gas into catalytic converter. Because there are great quantity of HC, CO in the gas. It can make over-oxidation in catalytic converter. The heat capacity from the reaction raises temperature of coverter too high to damage it. So do best to avoid that following conditions occur:

1) Idling too long;
2) Engine ignition time at improper time (too late);
3) Some spark plugs fail to operate;
4) Gas of the valves too small;
5) Fire period of the tension cable that is put out too long;
6) That start engine does not use ignition switch;
7) Drive injectors for long time but do not fire;
8) Many features that make mixed gas is too rich, like that oxygen fail to operate, that fuel pressure regulator fail to work (pressure too high), leakage in injectors, that TPS fail to operates etc.

• Conditions at using the tester

(1) Battery voltage: >8V

(2) **Fuse is normal.**

(3) **Ground lead of engine is connected properly.**

(4) Ignition switch: ON

(5) Must drive for more than 4 min before reading DTCs for any trouble related regulation of air/fuel ratio.

• Remove general troubles

Basic tools: tester, multimeter.

Which is inspected below should be the trouble which symptoms continue after removing

mechanism faults, which is related with EFI system.

Inspection for trouble symptoms

1) No starting

Means

(1) Does service light in meter light or not when Ignition switch ON ?

A. Not

- check fuse and ground lead;
- Test service light and its circuit with the tester;
- Inspect and repair the bulb and its circuit;
- Replace ECM.

B. light

- Connect the tester to diagnosis connector

(2) Can the tester communicates with the system or not?

A. Can't

- Check fuses and ground leads;
- Check ECM connector;
- Check the tester condition when it is used in a vehicle in normal condition;
- Replace ECM.

B. Can

- Remove troubles according to indications of the tester.

(3) Can sparks fire normally or not? –Ignition system check

A. Can't

- Check tension cables and sparks for coupling condition, such as damage or unproper;
- Check after replacing ignition coil;
- Check after replacing ECM

B. Can.

- Check connection of ignition coil and cylinders for order with tension cables;

(4) Fuel supply system check

1) Check order of inlet and outlet fuel pipelines;

2) Does fuel pump operate or not? – Listen to sound near fuel tank when engine operates

A. not

- Check fuel pump relay and its circuit;
- Check crankshaft position sensor (DELPHI system) and its connection;
- Replace ECM
- Check fuel pump circuit.

B. operate

- Check whether fuel pressure is more than 0.25Mpa;
- Check fuel filter, replace if necessary.
- Check inlet and outlet fuel pipeline;
- Check fuel pressure;
- Check control circuit of injectors;
- Clean injectors if necessary (once every 15000km).

2) Poor idling

No idling

Methods

- Check idling adjuster
- Check circuit and connectors of idling adjuster;

Engine racing during idling

Methods

1) idle control system check

• Check connector of idle control solenoids.

• Check that steps(50 – 159) of idling adjuster is in range and change in small level;

• Raise the steps for more 50 steps using the tester test actuator function of the tester. Check whether engine speed rises .

✧ If rise, stop engine, disconnect battery lead for 3 min, restart the engine.

✧ If no rise, replace throttle assembly.

2) Supply system check

• Check vacuum hoses for fuel regulator on fuel rail for connection and damage;

• Clean injectors if necessary.

Speed is too high in idling

Methods

It is normal condition if coolant temperature is lower than 68℃ or higher than 98℃. ECM raises idling speed to warm engine when coolant temperature is lower than 68℃. ECM raises idling speed to increase radiator capability when the temperature is higher than 98℃. Any trouble that is other than the tow conditions, should be checked in following steps:

• Check that steps(40 – 159) of idling adjuster is in range and change in small level;

✧ If steps change in too small level, check vacuum hoses on inlet manifold for connection and plug.

• Reduce the adjuster for 30 steps with actuator test function of the tester. Check whether engine speed reduces too.

✧ If engine speed doesn't reduce, replace throttle assembly.

3) Poor acceleration

- Check fuel filter for jam;
- Check fuel pressure and injectors;
- Reads on the tester is in normal range in idling or idling in high speed;
- Gas of crankshaft position sensor is too big.

Inspection for Intermittent Malfunction

(1) Inspection for parts not related to electrical circuit

- Must perform general service before doing the inspection. You can find trouble places usually with eyes, with shortened time. Inspection follows steps below:
- Check ground places for ECU and be sure these places cleanly and steadily..
- Check vacuum hoses and its coupling places to avoid leakage because of crack or disconnection;
- Check port places of throttle assembly and air inlet to avoid leakage;
- Check connection of tension cables for steady. Be sure that no cables have cracks or cut. Remove carbon on sparks
- Be sure that all connectors and terminals is connected steadily and properly.

(2) Poor connection

Most interment malfunction is results of poor connection. Check following places in detail:

- Be sure that harnesses connect and ground properly and steadily.
- Be sure that terminals of sensors are contacted properly and steadily;
- Be sure that connectors of sensors are not damage;
- Be sure that sensors is connected to harness properly and steadily.

(3) Service light lights intermittently

- If no DTC occurs, check following items:
- ECM ground poorly
- Relays operate poorly. Solenoids in ECM are driven or switched to lead interfere of electronic system;

- Low voltage circuit in ECM and ignition system grounds poorly;
- Circuit of service light or diagnosis connector short intermittently.

(4) Fuel system

Some intermittent malfunctions result of poor fuel. If engine stops suddenly or other malfunctions occur, ask users for fill:

Is the vehicle filled at same station? Is the vehicle fill with cheap fuel? If the answer is YES, may there is problem of fuel quality. Check fuel tank to look for deposit, water and other impurity.

4.2.3 Engine service (on-vehicle)

To check, replace or adjust following parts or components(Table 4-9) do not require to remove engine.

Table 4-9

Part or Component	correction
1 Spark Plug	Replace or inspect
2 Distributor	Replace, inspect or adjust
3 Exhaust Manifold	Replace or inspect
4 Oil Filter	Replace
5 Oil Pressure Sensor	Replace
6 Valve Chamber Cover	Replace or inspect
7 Rocker Arm Shaft	Replace or inspect
8 Rocker Arm	Replace or inspect
9 Rocker Arm Spring	Replace or inspect
10 Camshaft	Replace or inspect
11 Cylinder Head	Replace or inspect
12 Radiator	Replace or inspect
13 Radiator fan	Replace
14 Camshaft driven synchronization gear	Replace or inspect
15 Crankshaft drive synchronization gear	Replace or inspection
16 Timing chain	Replace

17 Oil basin and oil strainer	Replace or inspect
18 Inlet manifold	Replace
19 Alternator	Replace or inspect
20 Starter	Replace or inspect
21 Triangle belt for radiation fan.	Replace
22 Water pump	Replace, inspect or adjust
23 Chain pulley（crankshaft, generator, water pump ）	Replace or inspect
24 Synchronization chain cover	Replace or inspect
25 Cooling hose	Replace or inspect
26 Oil pump、piston、piston ring and connecting rod	Replace or inspect

4.2.4 Engine Removal

(1) Disconnect negative and positive wires from battery;

(2) Remove front seats;

(3) Disconnect lead and battery positive lead from starter;

(4) Disconnect battery negative wire from transmission;

(5) Disconnect backup switch;

(6) Disconnect flexible cable of odometer from transmission;

(7) Remove water inlet and outlet hoses of the heater.

(8) Disconnect the high tension cables from ignition coil.

(9) Disconnect leads from water temperature gauge and oil pressure switch;

(10) Remove air filter;

(11) Disconnect fuel pump and fuel line, disconnect fuel level gauge;

(12) Disconnect leads from alternator;

(13) Open fuel tank lid to reduce fuel gas pressure, and then close it;

(14) Remove inlet and outlet hoses from fuel rail;

(15) Remove acceleration cable from throttle body;

(16) Remove shift cable from transmission(Fig. 4-39);

(17) Lift the vehicle with lifter;

(18) Remove guard panel under engine;

(19) Drain out coolant and transmission oil;

(20) Remove clutch cable from clutch pedal and clutch arm;

(21) Remove propeller shaft;

(22) Remove muffle from outlet manifold;

(23) Remove clips for in and out hoses from block;

(24) Remove in and out hoses from radiator

(25) Remove in and out hoses from heater;

(26) Remove vacuum power hoses from inlet manifold;

(27) Remove inlet water hose for radiator;

(28) Put jack below engine assembly(include transmission), and place a thing between transmission and jack;

(29) Screw off bolts which engine beam is fitted with;

Caution

Inspect all connectors around the engine again; be sure all parts are removed before removing the engine.

(30) Screw off bolts on the back engine (Fig.4-40);

(31) Move engine backward to prevent to touch radiator fan and cover. Lift body and remove engine assembly;

(32) Remove clutch cover;

(33) Remove starter;

(34) Disconnect engine from transmission (Fig.4-42).

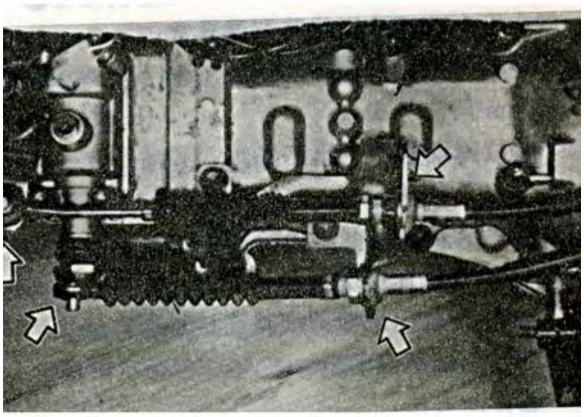


Fig.4-39

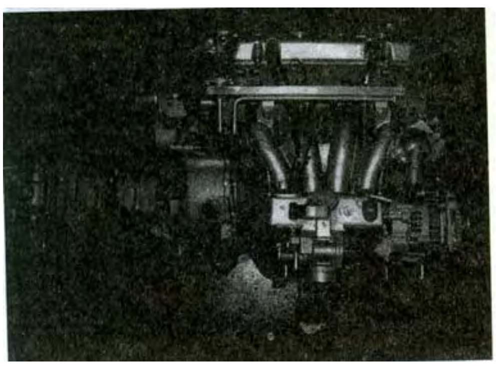


Fig.4-40

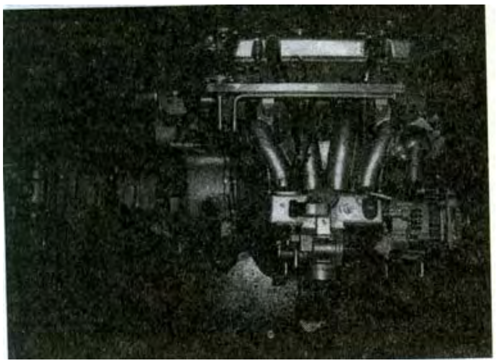


Fig. 4-41


Fig. 4-42

4.2.5 ENGINE DASSEMBLY

CAUTION

① Remember parts installing relation by observation for reassembly before bolts and nuts are removed.

② When parts made of Al-alloy are handled, you should do with great care. Because the parts is soft rather than parts of steel or steel –casting. The treated faces are easy to be scratched

③ Prepare part box. Put the parts in order. If necessary, mark them with marks or labels to distinguish an reassembly.

ENGINE DISASSEMBLY STEPS

(1) Remove oil filter assembly with special tool and drain the oil (Fig. 4-43);

(2) Remove pressure plate and friction pieces assembly (Fig. 4-44).

(3) Remove oil filter with special tool (Fig. 4-45);

(4) Loosen or remove alternator(Fig. 4-46);

(5) Remove belt for radiator fan (Fig. 4-47);

(6) Remove crank pulley (Fig. 4-48);

Remove cover for timing chain (Fig. 4-49);

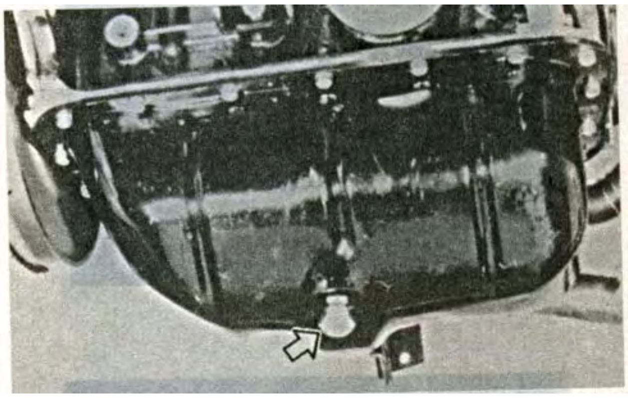


Fig. 4-43

Fig. 4-44

Fig. 4-45

Fig. 4-46

Fig. 4-47

Fig. 4-48

Fig. 4-49

(7) Remove timing chain (Fig. 4-50);

Fig. 4-50

Fig. 4-51

STEPS

- Remove screw for driven timing gear;
- Remove tensioner assembly
- Take timing chain;

CAUTION

It is necessary to rotate crankshaft before remove timing chain and tensioner to make drive timing mark on drive timing gear to the place that have 80 – 100 degree with the mark on lower part of inside lid in order to avoid collision with valves (Fig. 4-51), which may damage valve. Completed adjustment, do not rotate camshaft or crankshaft before removing head and arm.

(8) Remove inside lid (Fig. 4-52);

Fig. 4-52

Fig. 4-53

(9) Remove lower heat insulation plate on exhaust manifold (Fig. 4-53);

(10) Remove exhaust manifold and heat insulation pad (Fig. 4-54);

Fig. 4-54

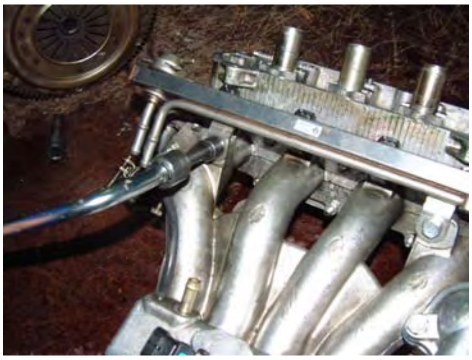


Fig. 4-55

(11) Remove fuel rail assembly (Fig. 4-55);

(12) Remove inlet manifold (Fig. 4-56) ;

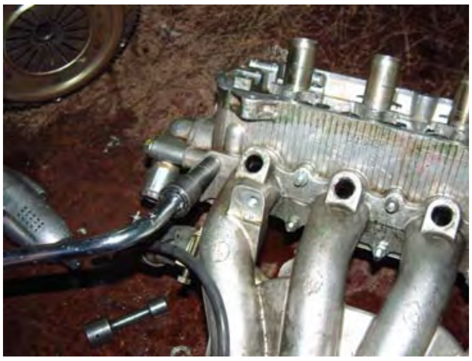


Fig. 4-56

(13) Remove PCV valve on cover of valves (Fig. 4-57);

Fig. 4-57

Fig. 4-58

(14) Remove valves cover assembly (Fig. 4-58);

(15) Remove end of camshaft (Fig. 4-59);

Fig. 4-59

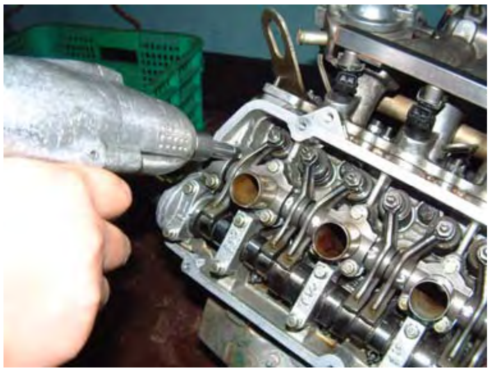


Fig. 4-60

(16) Remove arm shaft lid (Fig. 4-60);

NOTE
Front end covers of arm shaft are same as the rears. Middle arm shaft covers are same each other.

(17) Remove covers of camshaft bushes(Fig. 4-61);

Fig. 4-61

Fig. 4-62

NOTE: the covers have marks of every lines and forward;

(18) Take off intake arm and arm shaft(Fig. 4-62);

CAUTION

1. There are three types of arms: one is exhaust side arms, tow intake side arms (No.1 type of arm, No.2 type of arm, which arms on one side is same type.)
2. Rocker arm shafts are located only on intake side. The front is same as the rear(stop face up when assembling)
3. If it is not necessary, do not remove arms on exhaust side. Because there are clips on it to fix.

(19) Remove camshaft (Fig. 4-63);

Fig. 4-63

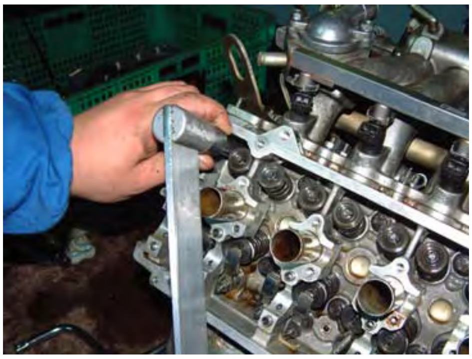


Fig. 4-64

(20) Remove cylinder head(Fig. 4-64);

(21) Remove valves springs and valves with special tool(Fig. 4-65);

Fig. 4-65

Fig. 4-66

(22) Remove water pump(Fig. 4-66);

(23) Remove engine brackets (Fig. 4-67);

Fig. 4-67

Fig. 4-68

(24) Remove front left and right brackets (Fig. 4-68);
(25) Remove oil collection pan (Fig. 4-69);
(26) Remove oil pump and oil collector assembly (Fig. 4-70);
(27) Remove rear end housing of crank(Fig.4-71);

Fig. 4-69

Fig. 4-70

Fig. 4-71

Fig. 4-72

(28) Remove covers of connect lever for 2, 3 cylinders, and push pistons out from cylinders bores(Fig.4-72);

CAUTION

Mark on faces of pistons before pushing it out. Do not knock big end of connecting rod at any time. if it is necessary to press, screw nut on the rod, and then press the nut with nonmetal part. Removed piston and connecting rod assembly, install the connecting rod cover.

(29) Push piston and connecting rod assemblies of 1, 4 cylinders with same method before.
(30) Remove crank main bearings covers and crank(Fig.4-73);

Fig. 4-73

4.2.6 Engine Overhaul

CAUTION
1. When and after disassembly, check cylinder block and cylinder head for mark of leakage or damage. Check them again after cleaning. 2. Clean all parts and components disassembled. Remove lubricant, earth, collected carbon and rust, and then check parts to decide which parts need to repair. 3. Remove rust on water line; 4. Clean oil holes and lines with compressed air; 5. Do not mix sets of valves, bearings bushs and bearings lids etc. Mark and place them independently;

- Cylinder head

1) Cleanout deposited carbon on cylinder head

Deposited carbon on combustion chamber faces and places near valves seats can make engine over-heat and low output and should be cleaned out.

CAUTION
Do not damage metal face and use sharp tool.

2) Distortion of gasket surface

Using a straightedge and a thickness gauge, check the gasket surface for distortion at total six directions. If the limit is exceeded, correct the head surface with abrasive paper. If necessary, replace the head.

Flatness of gasket surface: <=0.05mm

3) Distortion of exhaust manifold seating faces

Using a straightedge and a thickness gauge, check the seating faces of the cylinder head in order to determine whether the faces should be repaired or replace the cylinder head.

Flatness of exhaust manifold seating face: <=0.1mm.

4) The limit of inlet manifold seating face and method to check or repair is same as that of exhaust manifold retainer face.

- Rocker Arms

1) If adjusting screws for rocker arms is over-wear, replace it;
2) If there are over-wear on touching faces of rocker arm and cam, replace the rocker arm

- Valves

Check every face and stem of valves for wear, burnt out and distortion. Replace the valve if necessary.

Measure thickness of the valve head if the value measured exceeds the limit, replaces it.

Thickness sees Table 4-10

Table 4-10

Standard	Limit	
0.8～1.2mm	intake	0.6mm

	exhaust	0.7mm

- **Valve Seat**

1) Seating contact width

Produce a contact pattern on each valve in the usual manner, namely, by giving a uniform coat of Red-lead paste to the valve seat and by rotatingly tapping the seat with the valve head. The valve lapper (the tool used in valve lapping) must be used.

The pattern produced on the seating face of the valve must be a continuous ring without any break, the contact area should more than 75 percent of whole area, and the width of the pattern must be within specified range in Table 4-11.

Table 4-11.

Standard seating width revealed by contact pattern on valve face	intake	1.3～1.5mm
	exhaust	

2) Valve Seat Repair

A valve seat not producing a uniform contact with its valve or showing a width of the seating contact that is off the specified range must be repaired by regrinding or cutting and regrinding and finished by lapping.

Operate with special tools (valve seat cutter).

- Camshaft

It often results of over wear or bend of camshaft that there are great noise in valve chamber cover or that engine output is low. Wear often happen on face and stem of cams. Runout on stem of camshaft is used to indicate bend.

- Runout of camshaft

Table4-12

Runout limit	<=0.1mm

Support camshaft with tow sharp retainers. Measure runout of stems with a dial gauge. If the run out is out of the limit(Table 4-12), replace it .

- Cam face wear

Measure height(H) of the cams. If the height measured is below the limits, replace camshaft.

Table 4-13

Cam height	Standard	Limit
Intake cam (mm)	31.26±0.08	31.2
exhaust cam (mm)	29.5±0.08	29.4

- Camshaft journal wear

If the journal clearance exceeds the limit shown in Table 4-14, replace the camshaft and as necessary, cylinder head, too.

Journal clearance limit	Standard	Limit
	0.05～0.1mm	0.15mm

- Cylinder block

Flatness of top face of the block(contacting face with gasket)
Measure the flatness with the method same as that of cylinder head.
If the flatness exceeds the limits, repair.

Table 4-15

Flatness of top face of cylinder block	0.05mm

• Cylinder bore

Shown as figure, using a dial gauge, measure the cylinder bore in thrust and axial directions at three positions: top, middle and bottom. Six values are achieved. If the result of which the max value subtracts the min value exceeds the limit shown on Table 4-16, or there are scratches, roughness, or ridges, rebore all four cylinders. Use bigger pistons when assembly.

Table 4-16

Increased value of piston	Class Ⅰ	0.25mm
	Class Ⅱ	0.5mm

CAUTION

When one of four cylinders increases diameter, do other three cylinders too. And increase them to same level.

When pistons are replaced (include pistons that increase diameter), gas between piston and cylinder (on stem of piston) should be in the limit shown in Table 4-17

Table 4-17

Limit of diameter difference	0.05mm
Gas between piston and cylinder	0.04～0.06mm

● Pistons and Piston rings

- Check piston for faults, cracks or other damage. Light damaged piston is corrected
- Cleanout carbon on the top of piston and grooves of piston with soft friction tools;
- Measure side gap in each groove with dial gauge. If it exceeds the limit shown in Table 4-18, measure thicknesses of groove and ring to decide which part should be replaced;

Table 4-18

Items		Standard	Limit
Gap between groove and ring	First	0.04~0.075mm	0.12mm
	Second	0.03~0.065mm	

Table 4-19

Thickness of groove	No.1 ring	1.47～1.49mm
	No.2 ring	1.47～1.49mm
	Oil ring	0.45mm

Width of groove	No.1 ring	1.53～1.55mm
	No.2 ring	1.52～1.54mm
	Oil ring	2.81～2.83mm

• Piston rings clearance

To measure the end gap, insert the piston ring into the top of cylinder bore and then measure the gap by using the thickness gauge.

Table 4-20

Items		Standard	Limit
End gap of rings (mm)	No.1 and No.2 rings	0.15～0.35mm	0.7mm
	Oil ring	0.3～0.9mm	1.8mm

● Connecting rod

· Big-end side clearance

Check the big-end of connecting rod for side clearance, with the rod fitted and connected to its crank pin in the normal manner. If the clearance measured is found to exceed the limit, replace the connecting rod.

Table 4-21

Item	Standard	Limit
Big end side clearance	0.36～0.59mm	0.7mm
Width of big end of connecting rod	21.71～21.84mm	
Width of crank throw	22.2～22.3mm	

· Connecting rod alignment

Mount the connecting rod on the aligner to check it for bow and twist and, if the limit (Table 4-22) is exceeded, replace it.

Table 4-22

Limit on bow	0.05mm
Limit on twist	0.10mm

· Crank pin and small-end of connecting rod

Inspect the clearance between piston pin and small end of connecting rod. If it is found to exceed the limit (Table 4-23), replace the connecting rod or the piston pin.

Table 4-23

Items	Standard	Limit
Clearance between piston pin and groove	0.0125～0.0175mm	0.05mm

Inside diameter of small end groove	16.005～16.015mm	
Diameter of piston pin	15.99～16.00mm	

· Rod bearing shell

Inspect the bearing shells for signs of fusion, pitting, burn or flaking and observes the contact pattern. Bearing shells found in defective condition must be replaced.

> CAUTION
>
> Do not correct the bearing shells with sand paper or other method. If any sign whichis illuminated before occurs, replace the shell.

Clearance of rod shell (see Table 4-24)

Table 4-24

Items	Standard	Limit
Clearance of bearing shell(mm)	0.02～0.043mm	0.08mm

●Main bearing shell, crank shaft and cylinder body

Inspection

• Crankshaft

· Crankshaft runout:

Measure the runout at the centre journal. Rotate the crank shaft slowly. if this runout exceeds the limit, replace crankshaft.

Limit on runout	0.06mm

• Crankshaft thrust play

Measure this play with crankshaft set in the cylinder block in the normal manner, that is, with the thrust bearing fitted and journal bearing caps installed. Tighten the bearing cap bolts to the specified torque.

Use a dial gauge to read the displacement in axial (thrust) direction of the crankshaft.

If the limit (Table 4-26, 4-27) is exceeded, replace the thrust bearing by ne standard one or oversize one to obtain the standard thrust play.

Table 4-26

Item	Standard	Limit
Crankshaft thrust play	0.1～0.3mm	0.4mm

Table 4-27

Thickness of crankshaft thrust bearing	Standard I	2.4～2.5 mm
	Standard II	2.5～2.6 mm
	Oversize	2.6～2.7 mm

- Main bearings

· Inspect main bearings with same method as that of connecting rod bearings.

· The limit on the clearance of main bearings sees Table 4-28

Table 4-28

Item	Standard	Limit
Bearing clearance	0.022～0.041mm	0.08mm

- Oil seal

Carefully inspect the oil seal for wear of damage. If the lip portion is worn or damaged, replaces the oil seal.

It is a suggestion that replace oil seal removed with the new one.

CAUTION

Keep rubber parts clearly. Do not wrinkle or have water or oil on them (except fuel line).

4.2.7 ASSEMBLY ENGINE

CAUTION

1. All parts to be installed must be perfectly clean;
2. Apply engine oil on slip and friction faces of parts;
3. Apply liquid seal glue on specified places to avoid water or oil leakage;
4. Check every clearances of rotated parts during assembly;
5. keep gaskets, o-rings and other seal parts in normal condition. Use new parts to replace them.
6. Specify tightening torques for main parts or main bolts and nuts for other parts in the manual. Use torque wrench and refer to the manual;
7. Pay attention to matching marks, which some of them do during removal;
8. Sets of parts, such as crankshaft bearings, connecting rods and pistons should not be disturbed and try to see that each part goes back where it came from, where installing.

Assembly sequence is in reverse of that of disassembly. Some steps are related to the measures used in factory. Followings illuminate these steps.

- Crankshaft

· Apply oil to crankshaft journals and journal bearings;

· Thrust bearings to cylinder block. Face the oil groove sides to crank webs

· Apply oil to crankshaft journals. And then install bearing caps. Apply oil to move place of connecting rods.

· When fitting the bearing caps to journals after setting the crankshaft in place, be sure to point the arrow mark (on each cap) to front end of engine. Fit them sequentially in the ascending order, ,1,2,3,4,5, starting from front end side;

· Check to be sure that crankshaft rotates smoothly when turned over by hand. Tightening torque is 1.2kg.m.

- Oil seal housing

· Remember that the o-ring on oil pump should be fitted.

- Pistons, piston rings and connecting rods

· Locations of pistons and connecting rods

· Point mark of triangle recession or circuit recession on piston head to front end of engine. Oil hole of connecting rod should be located on intake side.

CAUTION
Apply engine oil to hole on small end of connecting rod and of piston pins.

· Distinguish No.1 ring and No.2 ring. No.1 ring has a mark of "ATG" and No.2 ring has a "AT". Point the marks to piston head. Journal ends of the tow rings has angle of 180 degree and journal end of oil ring has angle of 90 degree with near ring.

· Hold the ring compressor firmly against the cylinder block until all piston rings have entered the cylinder bore to avoid that journal ends location change or damage piston and piston rings.

· Connecting rods

· After insert assembly of piston and connecting rod into cylinder bore, install the cap to the rod. When installing the cap to the rod, put tow thrust slot on same side as shown in figure below.

· Have mark on the cap too, as shown in figure below;

· After fitting assembly of of piston and connecting rod, check to be sure marks of crankshaft front end, recession on piston head, forward on bearing cap etc.

- Cylinder gasket assembly

The gasket is a very important part. The part have very close relation to engine output and other performance features. Check appearance for damaged signs of separation, recession etc.

There is one place of the gasket fitted, with "IN" mar on intake side and "EX" on exhaust side. Throttle hole should be see throng hole for throttle hole on the gasket after installed correctly.

- Rocker arms

Intake rocker arms are different from exhaust rocker arms. First install rocker arms on exhaust side (to front of camshaft) and then rocker arms on intake side (to back of camshaft).

It is easy to install exhaust rocker arms. Press rocker arms into its seat on cylinder head(sound of clip should be heard when completing installation), and then rotate it to the place where cams is on valves (there are tow locate ears on contact places of rocker arms and valves. The ears wrap heads of valves when installed correctly, which should be inspected before tightening camshaft cover).

It is easy too to install intake rocker arms. Insert rocker arms into rocker arm shafts (the arms on the front are same as that on the back. The arms on the middle are same.), and then install cylinder head. Carefully install front and back arms with plate faces upward (there are locate faces on rocker arm caps).

The camshaft should be rotated smoothly after installing camshaft and rocker arms.

- Timing mechanism

A. Driven synchronous gear

Point the face which have a recession on outward. There is a mark of key slot on camshaft. Rotate the gear to point the recession alignment with the mark on inside cap, which ① means TDP of the first cylinder and ② means TDP of the fourth cylinder.

CAUTION

Be sure that key slot of crank locates 80 - 100 degree before completing the operation).

B. Drive synchronous gear

Put stop washer on crank before installing drive synchronous gear. Point lip of the gear to block, and then use the slot as a standard point, insert drive synchronous gear to crank. Rotate the gear to align the slot with mark ③.

C. Install tensioner assembly, tension spring and stud into belt inside cover. Tighten bolts and bush until the tensioner could be moved easily by hand.

D. Install the timing belt on tow pulleys in such a way that first on drive synchronous gear and then on driven synchronous gear. Press tensioner.

Rotate clockwise for tow cycles after installed. Align slot on driven gear and marks of ①, ②, ③ to a line. If not, do again.

4.2.8 Inspect and adjust engine

- Timing belt

Timing belt is expendable. Inspect the belt for damage, crack, wear and dirty. If the belt is polluted with oil or have sign of wear, replace timing belt at once, which avoid great trouble of rupture.

- Valve clearance

1) 16M engine:

At cold, intake: 0 .08mm , exhaust: 0.1mm;

At warm, intake: 0 .1mm , exhaust: 0.12mm;

2) adjustment

First, remove valve chamber cover. And then adjust exhaust valves clearances, with the rocker arm arc face on camshaft basic circle. Adjust them in order of 1, 2, 3, 4 cylinder by special tools as shown in figure below. Adjust intake valves clearance by same method.

CAUTION

After the operation, rotate crank for tow cycles to inspect valves clearance in the limit.

- Spark plug clearance
  - Standard: 1.0±0.1mm;
  - Inspect spark clearance and carbon regularly because it is related to engine combustion.

- Cylinder compression pressure

Cylinder compression pressure is an important factor for engine combustion. It is related to engine power. Measure method is shown below:

1) Remove all spark plugs;

2) Install special too (Compression gauge) into spark plug hole;

3) Disengage the clutch (to lighten starting load on the engine , and depress the accelerator pedal all the way to make the throttle full-open;
4) Crank the engine with the fully charged battery, and read the highest pressure on the compression gauge;
5) Carry out the steps 3 through 4 on each cylinder to obtain four readings

Standard compression pressure sees Table 4-29.

Table 4-29

Standard (kg/cm^3)	Limit (kg/cm^3)	Max. difference between any tow cylinders (kg/cm^3)
13.5/300r/min	10.5/300r/min	1/300r/min

4.3　DA471QLR engine series

4.3.1General description

DA471QLR engine series are four in-line, water-cooled, 4-stroke cycle gasoline unit with its D.O.H.C. (Double overhead camshaft) valve mechanism arranged for “V”-type valve configuration, sixteen valves (every cylinder has two inlet and outlet valves) (Fig.4-74). Valves opening and closing separately through camshaft that is driven by crankshaft through synchronizing chain. The engine adopts MPI system of UAES, The content of the vehicle exhaust deleterious gas is reduced out and away. It can reach the green environmental-protection power of new emission regulation completely.

DA471QLR engine series adopts MPI system, and controlled by ECU (electronic control unit) according to the signals, which send out by the sensors including inspecting engine-working condition sensors. Administer equipment works controlled by ECU system, which has the functions of fuel injection controlled, idle controlled, ignition timing controlled. ECU also can simplify diagnostic mode when trouble happened.

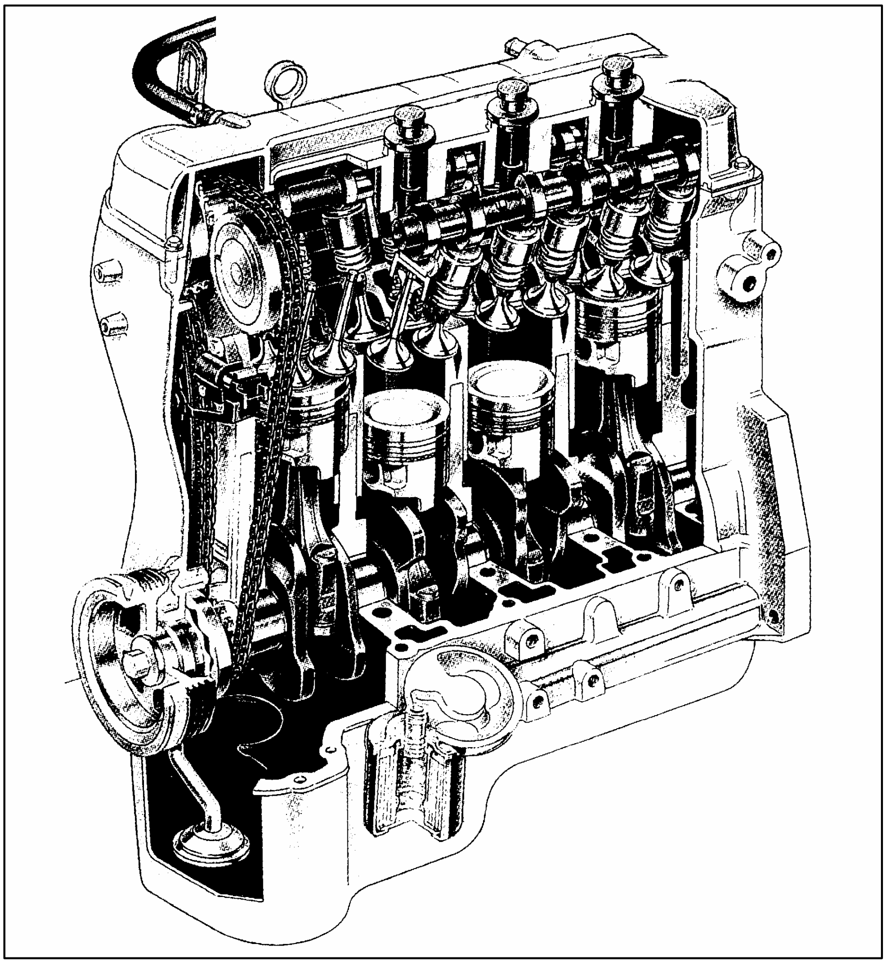


Fig.4-74

●ENGINE CHARACTERISTIC（Fig. 4-75）

• CYLINDER

Cylinder materiel is casting- aluminum alloys, in-line 4-cylinders and each has casting bush.

• CRANKSHAFT AND MAIN BEARING

Crankshaft is block-forging type and supported by 5 main bearings. the crank pin angle is 180°

• piston connecting-rod assy.

Materiel of piston is casting- aluminum alloys. Piston ring assy is made up of 2 compressions rings and 1 oil ring. In the 2 compression rings, the first ring is chrome plated on the surface in order to improve wearability. The oil ring is made up of 2-plane ring and 1 labyrinthic ring; offset of piston pin is 0.5mm toward main thrusting face in order to reduce impingement from piston to cylinder wall. Material of piston pin is Chromium alloy steel, piston and connecting rod is assembled by full floating way. The connecting rod use cast steel materiel and assort with bearing by over surplus.

• cylinder cover and valve system

Materiel of cylinder cover is casting- aluminum. Cam bracket and camshaft bearing cover is separate. There are 4 valves in chamber, middle position spark plug, Fastigium chamber has higher intake and exhaust ratio.

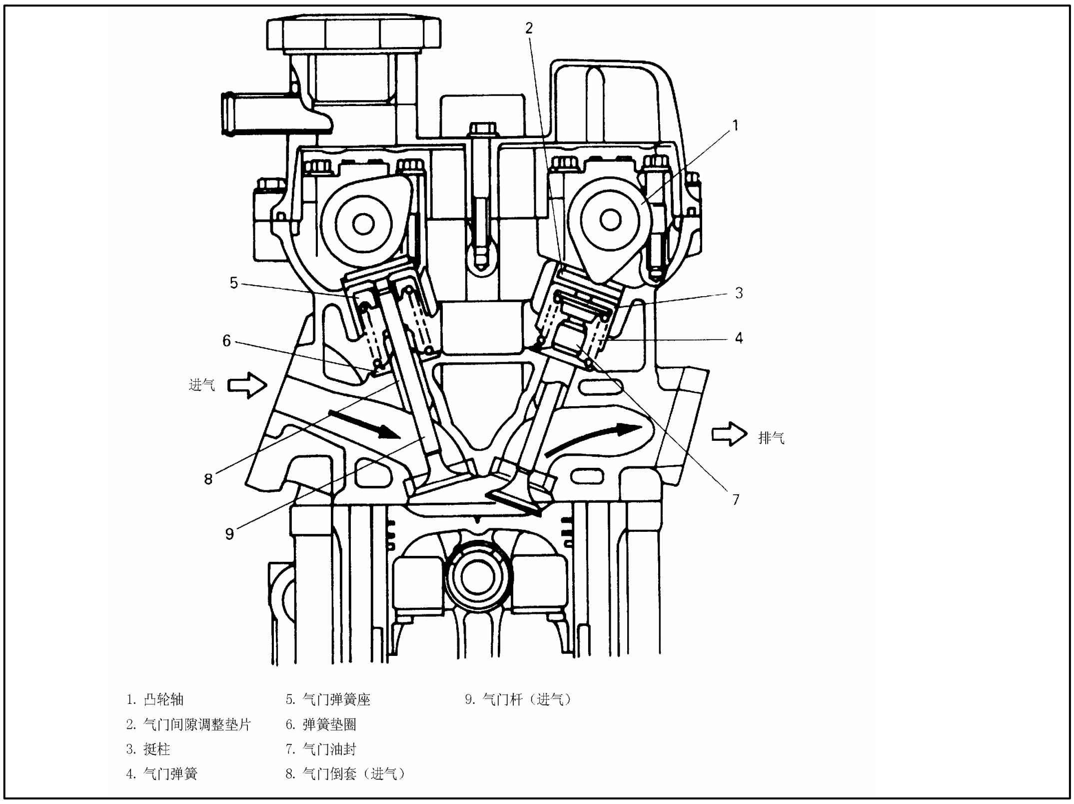


Fig. 4-75

4.3.2 ENGINE MANAGEMENT SYSTEM（EMS）

4. 3. 2. 1 GENERAL DESCRIPTION

DA471QLR type engine adopts BOSCH M7 **EMS** that has grouping ignition, sequential injection, knock closed-loop control, idle closed-loop control, canister control, A/C control function etc.

Electronic fuel injection engine uses closed-loop control management system. ECU (system core electronic control unit) calculates the volume of air by the signal of intake air pressure sensor, engine speed sensor and intake temperature sensor and then confirms the injection amount of each cycle, corrects it by the signal of coolant temperature sensor. Because fuel pressure adjuster keeps the difference of injector' s inner pressure and outer pressure constantly, and the injection section is fixed, so ECU can control the amount of injection each cycle by controlling injection time. At air/fuel(λ) closed －loop control status , ECU corrects the amount of injection by the signal of oxygen sensor, keep theory air/fuel ratio . So the catalytic converter can clean exhaust furthest，decrease exhaust content such as CO,HC, and NOX, make the automobile exhaust reach the European level in the middle age of 1990s, and become lower exhausted green environment-protection automobile.

4.3.2.2 IDLE SPEED CLOSED-LOOP CONTROL THEORY

At idling，release the accelerator pedal fully，ECU knows idle operation conditions of load and temperature information provided by throttle position sensor and coolant temperature sensor, and decide idle speed according to predicted value.

When the engine starts at the first time，ECU decides the position of idle speed adjuster through “self －study ”.It is ：If the actual speed provided by speed sensor is different from predicted value， change the section area of idle air channels by idle adjuster， adjust air volume and fuel amount charging cylinder，make the actual speed access to predicted value, and same at last. ECU can remember the position of idle adjuster at this moment.

When ECU recognize the idle operation conditions once more, it would control idle adjuster to idle position straightly，and adjust slightly according to load conditions. When A/C switch turn on，ECU control idle adjuster to correct predicted value，increase the idle speed.

4.3.2.3 IGNITION TIMMING AND KNOCK ELECTRNIC CONTROL THEORY

ECU confirm spark advance angle enactment value according to load and speed information, and correct it according to coolant temperature, acceleration and drag information ,get the suit spark advance angle, so confirm ignition timing. Once the knock signal occurs，ECU puts off spark advance angle at once，till the knock signal disappears.

4.3.2.4 COMPONENTS OF EMS

EMS consists of sensors, electric control unit (ECU) and actuators (Fig.4-76)。

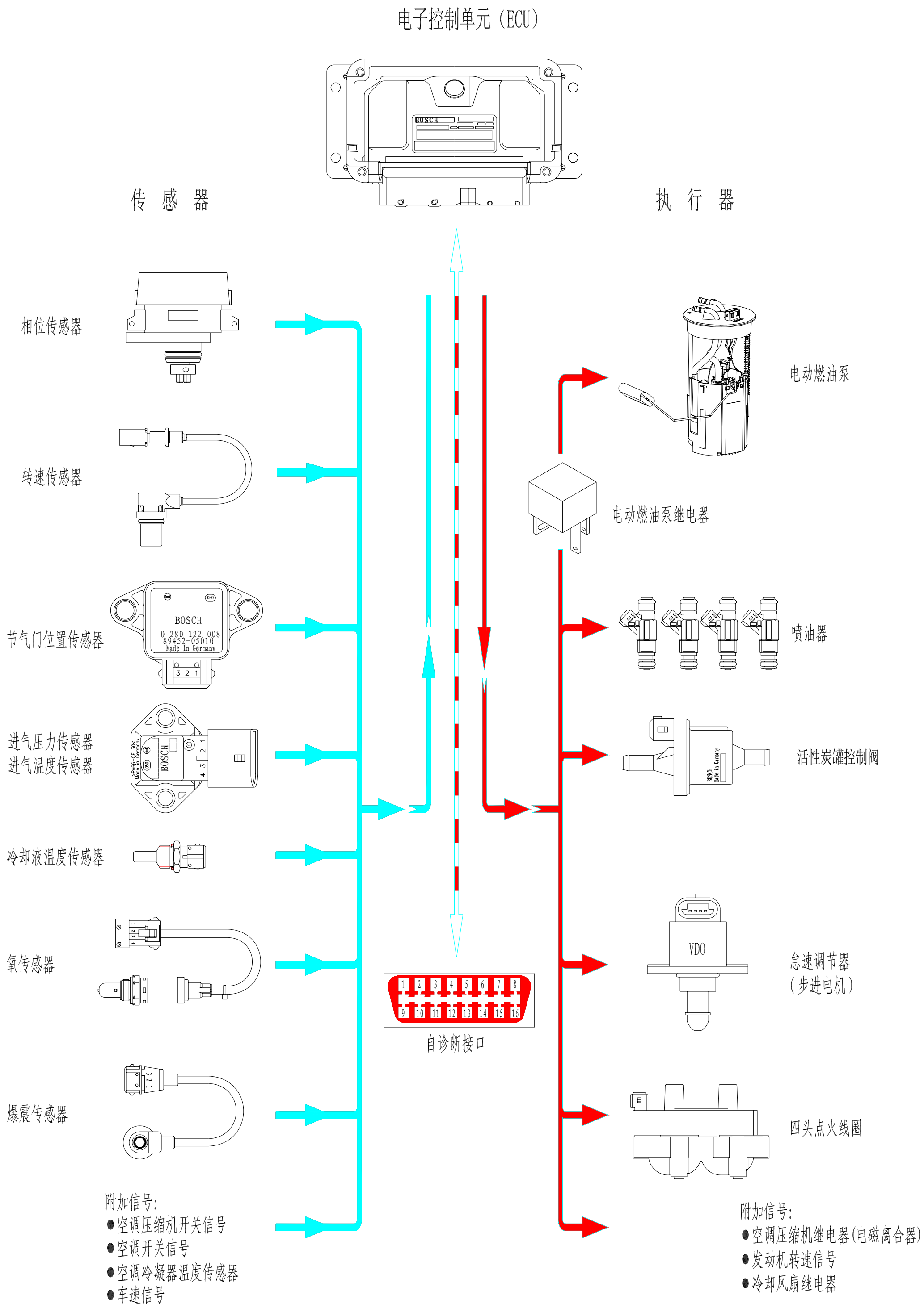


Fig. 4-76 COMPONENTS OF EMS

传感器：sensor;执行器：actuator;活性炭罐控制阀：Canister purge valve；进气压力/温度传感器：Intake pressure and temperature sensor；曲轴相位传感器：crankshaft phase sensor；四头点火线圈：four-post-in ignition coil;氧传感器：Oxygen sensor;爆震传感器：Knock sensor；电动燃油泵：Electronic fuel pump；电动燃油泵继电器：Electronic fuel pump relay；转速传感器：engine speed sensor;喷油器：**Fuel** injectors；冷却液温度传感器：Coolant temperature sensor;节气门位置传感器：Throttle position sensor;怠速调节器（步进电机）：idle speed adjuster（stepper motor）;附加信号:accessional signal;空调压缩机开关信号:A/C compressor ON/OFF signal；空调开关信号:A/C switch signal 空调冷凝器温度传感器：A/C evaporation temperature sensor；车速信号：vehicle speed signal；空调压缩机继电器（电磁离合器）：A/C compressor relay(electromagnetic clutch);发动机转速信号 ENG. rotation speed signal; 冷却风扇继电器：cooling fan relay.

1. SENSOR

1） Throttle position sensor（Fig.4-77）：be installed on throttle assembly coaxially (throttle assembly install on the front end of intake pipe)，provide load, load range and acceleration information.

2) Intake pressure sensor（Fig.4-78）：Be installed on the intake manifold stable pressure chamber to offer engine load information.

3) Intake temperature sensor（Fig.4-78）：integrated with manifold intake pressure sensor，offer air temperature information which is used to confirm amount of injection and ignition timing.

4) Coolant temperature sensor（Fig.4-79）：be installed on thermostat seat，offer coolant temperature information to correct the amount of fuel injection and ignition timing

5) Oxygen sensor：be installed between engine and 3-way catalytic converter（Fig.4-80），offer mixture rich/lean information to correct amount of fuel injection，achieve the closed-loop control of air/fuel ratio.

Fig.4-77 throttle position sensor

Fig.4-78 intake pressure and Temperature sensor

Fig.4-79 coolant temperature sensor

Fig.4-80 oxygen sensor

6) Knock sensor: install on the intake side of engine block (Fig.4-81), offer knock information used to correct ignition timing, achieve the closed-loop control of knock.

NOTOCE:
DON’T ADD ANY GASKET OR LOCK PARTS WHEN INSTALL KNOCK SENSER, ONLY PERMITTED TO FIX IT WITH BOLT, TIGHTENING TORQUE IS 15-25N.M

7) Crankshaft phase sensor: be installed on the backside of cylinder head (Fig.4-82), offer information which can distinguish TDP of the first cylinder.

8) Rotation speed sensor: be installed on the front end of transmission case (Fig.4-83), offer crankshaft speed and phase information, phase information of crankshaft is the consult point of injection timing and ignition timing.

Fig.4-81 knock sensor

Fig.4-82 crankshaft phase sensor

Fig.4-83 rotation speed sensor

Fig.4-84 fuel rail assembly

2. Electronic control unit (ECU)

ECU sends order to actuators after analyze the input signals of sensors.

3. Actuator

1) Electronic fuel pump: Be installed in fuel tank, ECU controls fuel pump work through fuel pump relay, once engine stop working, electronic fuel pump stop automatically.

2) Fuel injectors: Be installed on the fuel rail assembly (Fig.4-84), it inject fuel toward

air passage by ECU control.

3) Four post ignition coil (Fig.4-85): ECU controls switching on or cutting off the primary circuit to ignite.

NOTICE: IGNITION COIL'S INSTALLING SEAT MUST CONNECT GROUND FIRMLY

Fig.4-85 four post ignition coil

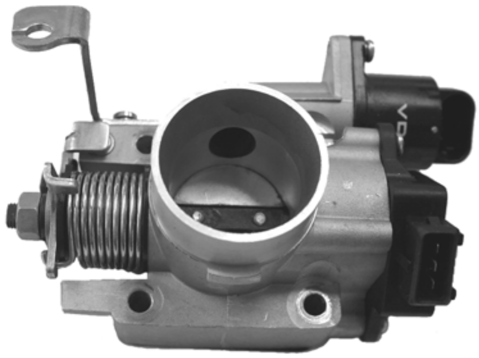


Fig.4-86 throttle body assembly

4) Idle adjuster (stepper motor): Be installed on the throttle body assembly (Fig.4-86), ECU controls its action and change section of by-pass path, and change the amount of by-pass air to control idle speed.

5) Canister purge valve (Fig.4-87): Be installed on body-frame, ECU control its opening range to control the amount of clean air flow from canister to inlet manifold.

Fig.4-87 canister purge valve

4.3.3 ENGINE'S INSPECTION (NOT REQUIRE ENGINE REMOVAL)

The following parts or components shown as table 4-39 do not require engine removal to receive services (replacement, inspection or adjustment):

Table 4-39

Part or Component	correction

1. Spark Plug	Replace or inspect
2. Exhaust Manifold	Replace or inspect
3. Oil Filter	Replace
4. Oil Pressure Sensor	Replace
5. Valve Chamber Cover	Replace
6. Rocker Arm Shaft	Replace or inspect
7. Rocker Arm	Replace or inspect
8. Rocker Arm Spring	Replace or inspect
9. Camshaft	Replace or inspect
10. Cylinder Head	Replace or inspect
11. Radiator	Replace or inspect
12. Camshaft driven synchronization gear	Replace or inspect
13. Crankshaft drive synchronization gear	Replace or inspect
14. Timing belt	Replace
15. Oil pan and oil strainer	Replace or inspect
16. Inlet manifold	Replace
17. Alternator	Replace or inspect
18. Starter	Replace or inspect
19. Water pump	Replace
20. Chain pulley (crankshaft, generator, water pump)	Replace, inspect or adjust
21. Synchronization chain cover	Replace or inspect
22. Cooling hose (tube)	Replace or inspect
23. Oil pump、piston、piston ring and connecting	Replace or inspect
rod	Replace, inspect
24. Water pump chain pulley	Replace or inspect

4.3.4 ENGINE REMOVAL

- Remove the guard stone under the engine;
- Unscrew the water drain plug of the radiator and cylinder , drain off coolant;
- Disconnect the battery positive wire from the engine;
- Disconnect the battery negative wire from the transmission;
- Disconnect the connector of backup lamp switch;
- Disconnect flexible shaft of odometer from transmission

- Disconnect water inlet and outlet hose of the heater;
- Disconnect the high tension cable from ignition coil;
- Disconnect all kinds of sensors and actuators connections as shown tabel4-40:

Table 4-40

Number	Name	Position
1	Intake temperature pressure sensor	Inlet manifold stable pressure chamber
2	Throttle position sensor	Throttle assembly
3	Rotation speed sensor	Transmission front housing
4	Knock sensor	Intake side of cylinder block
5	Crankshaft phase sensor	Backside of cylinder head
6	Coolant temperature sensor	Thermostat seat
7	Water temperature sensor	On the tie-in of inlet water hose
8	ECU	Body
9	Idle adjuster	Throttle assembly
10	Canister purge valve	Body (near the canister)

- Disconnect positive wire of alternator;
- Remove A/C pipes from compressor according to A/C removal procedure;
- Disconnect accelerator cable from throttle body assembly;
- Disconnect injectors;
- Disconnect crankcase bleed pipe from air filter;
- Disconnect intake hose from throttle body assembly;
- Disconnect inlet and return fuel hoses from fuel rail assembly;

CAUTION

BECAUSE PRESSURE IN THE FUEL PIPES IS VERY HIGH WHILE THE ENGINE IS STOPING, DISCONNECT FUEL HOSE AFTER DRAINING FUEL, IN ORDER TO AVOID FUEL FROM EJECTING AND DANGER HAPPENING.

- disconnect water inlet and outlet hose from radiator;
- disconnect cable of clutch;

- disconnect oxygen sensor lead;
- Remove muffler from exhaust manifold and body frame;
- Remove drive shaft;
- disconnect gear shift control cables from the transmission;
- Remove the under cover of radiator;
- Support engine and transmission;
- Remove connecting bracket of transmission from vehicle frame;
- Remove engine member assy from vehicle frame;
- Remove front cross member assy from the engine;

> CAUTION
>
> INSPECT ALL CONNECTORS AROUND THE ENGINE AGAIN; BE SURE ALL CONNECTORS ARE REMOVED BEFORE REMOVING THE ENGINE.

- Raise the vehicle body, remove the engine assy (including engine member assy. And front crossbeam assy);
- separate engine member assy from the engine assy;
- Remove the under cover of clutch;
- remove the starter;
- separate the engine assy from the transmission.

4.3.5 ENGINE DISASSEMBLY AND ASSEMBLY

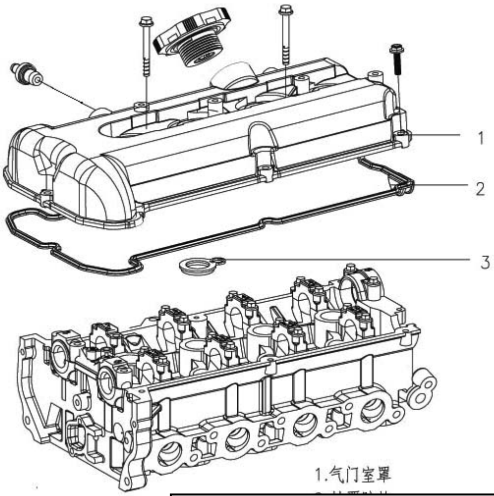
●valve chamber cover assembly
Disassembly

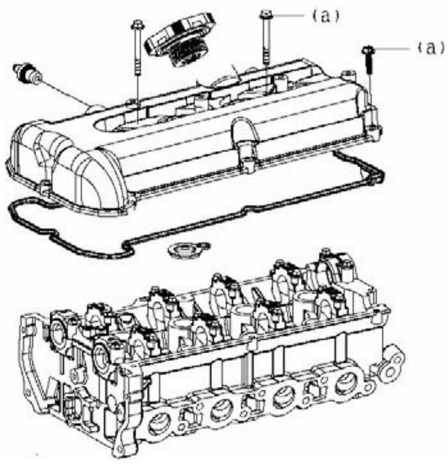
1) disconnect cathode of battery;

2) Remove high tension ignition coil and high tension leads assembly;

3) pull out PCV valve assembly and crankcase bleed hose;

4)Remove valve chamber cover assembly, sealing gasket and spark plug seal washer shown as Fig. 4-88。





1. valve chamber cover
2. sealing gasket
3. spark plug sealing washer

Fig.4-88

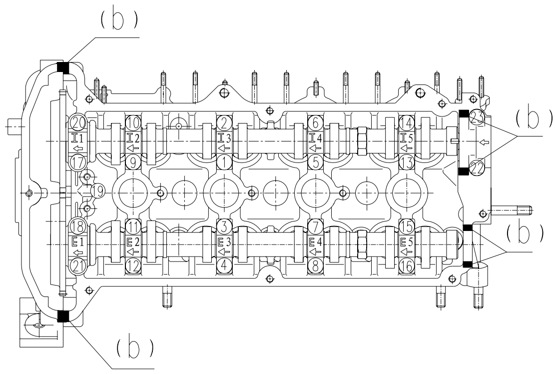
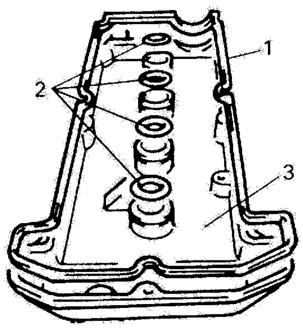


Fig.4-90

ASSEMBLE

1）Install sealing gasket and spark plug sealing washer to the valve chamber cover assembly shown as 4-89。

CAUTION：
INSPECT SEALING GASKET AND SPARK PLUG SEALING WASHER BEFORE FIXING IF DAMAGED PLEASE REPLACE IT



1. Sealing gasket
2. spark plug sealing washer
3. valve chamber cover

1. 封严胶垫
2. 火花塞密封圈
3. 气门室罩

Fig.4-89

2）install the valve chamber cover assembly and tighten the bolt to specified torque after apply oil proof silicon ketone sealant HZ1213 at location（b）as shown in Fig. Fig.4-90。

Tightening torque

（a)：11 N·m

CAUTION：
DON'T MAKE THE SEALING GASKET AND SPARK PLUG SEALING WASHER DIVORCED FROM MOUNTING GROOVE WHEN MOUNTING.

3）install crankcase bleed hose and PCV valve hose，then fix the clip.

4）install high tension ignition coil and high tension leads assy.

5）Connect the cathode of battery correctly.

●THROTTLE BODY ASSEMBLY AND INTAKE MANIFOLD

DISASSEMBLY shown as Fig.-91

1）release fuel pressure according to related chapter.

2）disconnect the cathode of battery.

3）drain coolant according to related content of cooling system

CAUTION：
IN ORDER TO AVOID SCALD，DON'T OPEN THE RADIATOR COVER AND UNSCREW DRAIN WATER PLUG BEFORE ENGINE AND RADIATOR COOL DOWN. HOT COOLANT AND HIGH PRESSURE STEAM WILL EJECT OUT IF OPEN RADIATOR COVER AND UNSCREW DRAIN WATER PLUG TOO EARLY.

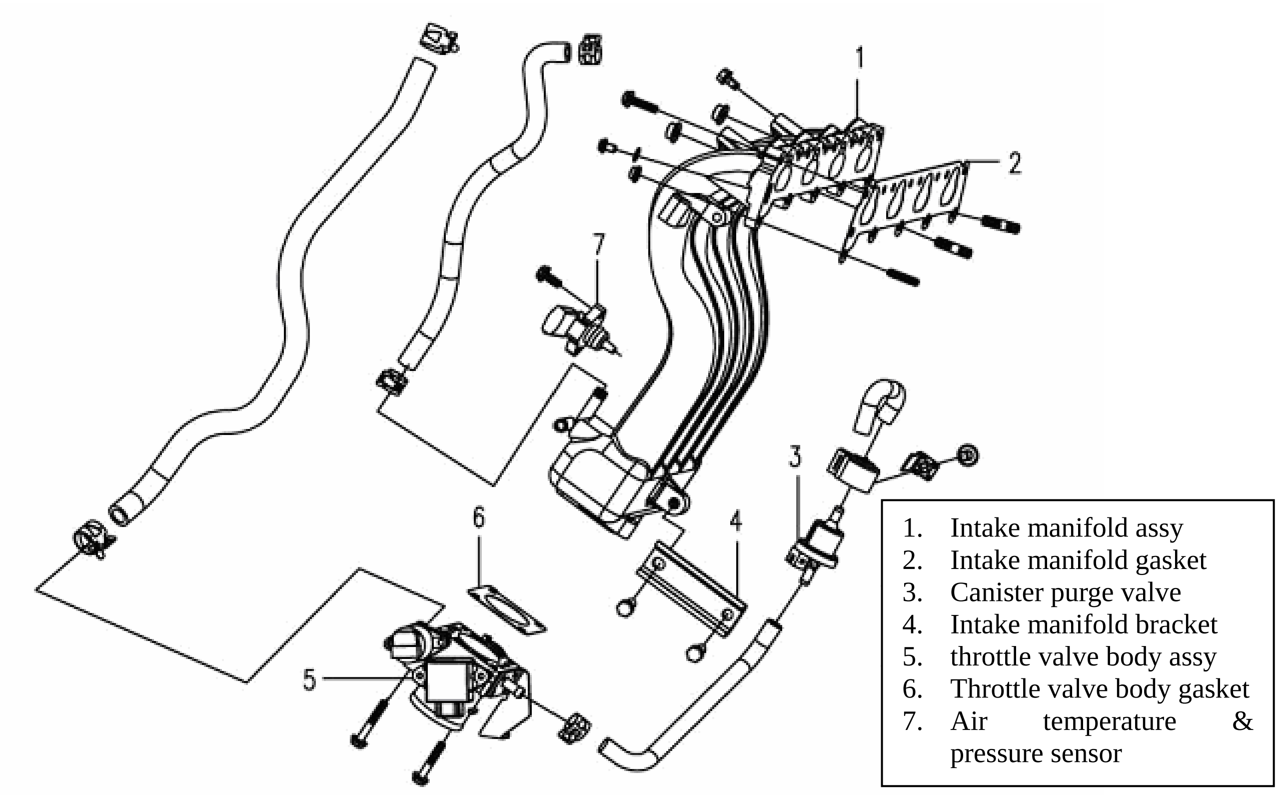


Fig. 4-91

4) Remove accelerator cable;

5) disconnect injector, throttle position sensor, intake temperature & pressure sensor, water temperature sensor and stepper motor plug;

6) Remove hose as follow:

(1) disconnect vacuum booster brake hose;

(2) Remove fuel gas purge which connected to throttle valve body;

(3) disconnect PCV valve hose;

(4) disconnect inlet oil hose;

(5) disconnect return water hose;

7) Remove screw which connect to intake manifold bracket, intake hose and dipstick pipe bracket.

8)disconnect throttle body and inlet manifold, then remove inlet manifold gasket.

ASSEMBLY

Engine assembly is the reverse of engine disassembly. but please notice questions as follow:

1) install a new inlet manifold gasket。

CAUTION

YOU MUST APPLY SEAL GLUE #50 AT BOTH SIDE OF INTAKE MANIFOLD GASKET BEFORE INSTALLATION.

2) tighten screw and nut to specified torque shown as Fig. 4-92。

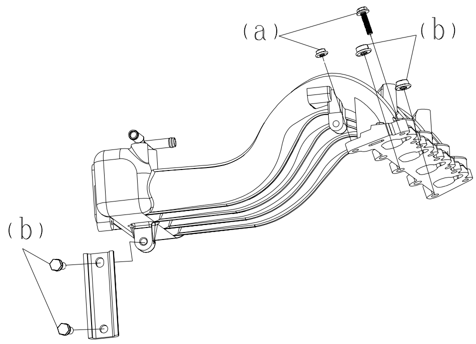


Fig.4-92

TIGHTENING TORQUE

(a) 10 N•m (M6)

(b) 23 N•m (M8)

inspect and insure all the component which removed are mounted completely.

3) Refill coolant referring to content about cooling system.

4) inspect fuel system for leakage according to relative chapter after assembling.

finally, start engine and inspect coolant for leakage.

●Exhaust manifold shown as Fig. 4-93

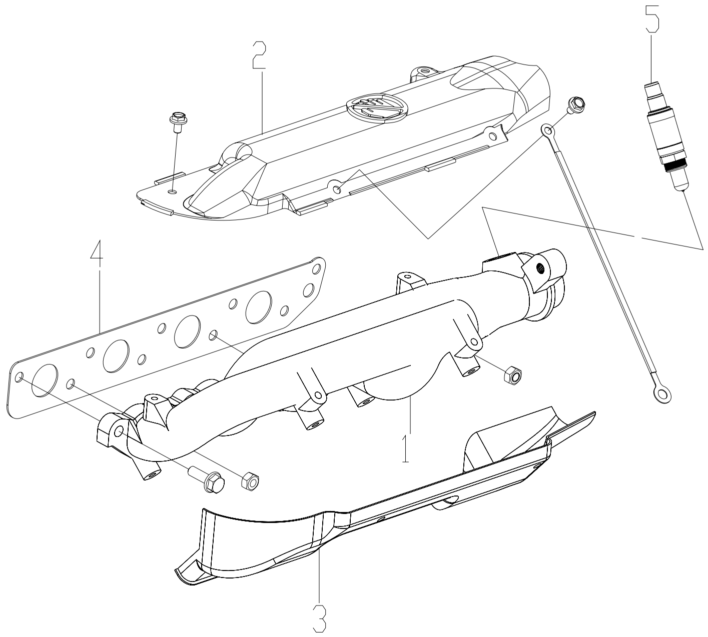


Fig.4-93

1. Exhaust manifold cover assy 2. Exhaust manifold heat protector upper
3. Exhaust manifold heat protector lower 4. Exhaust manifold heat protector
5. Oxygen sensor

> CAUTION
>
> DON'T SERVICE WHEN THE EXHAUST SYSTEM IS HEAT AVOIDING TO BE SCALDED. SERVICE OF EXHAUST SYSTEM SHOULD BE DONE AFTER IT COOLS DOWN.

DISASSEMBLY

1) disconnect the cathode of battery;

2) disconnect oxygen sensor wiring harness;

3)Remove exhaust manifold heat protector upper and lower assembly and ground harness assy;

4) disconnect the connection between muffler and exhaust manifold shell;

5) Pull out bypass hose which connect to water inlet assy;

6) Remove engine water inlet assy;

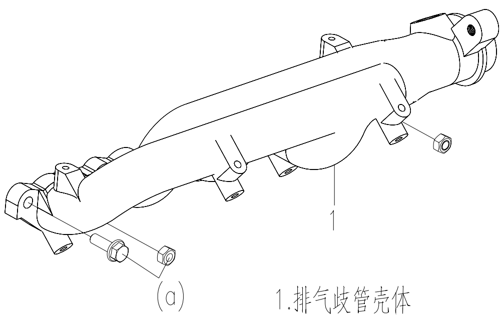
7) Remove exhaust manifold shell and exhaust

manifold gasket assembly.

ASSEMBLY

1) Inspect if exhaust manifold gasket assembly damage, if yes then replace it , if no then install it.

2) Install and tighten exhaust manifold shell screw and nut to specified torque shown as Fig. 4-94, but please don't install the screw for fixing water inlet hose on the exhaust manifold pipe.



Exhaust manifold shell

Fig.4-94

Tightening torque

(a):23 N•m

3) Install water inlet pipe assy, tighten the screw with specified torque for fixing water inlet pipe on the exhaust manifold pipe.

4) Install bypass hose connected to the water inlet pipe assy, then tighten the clip.

5) Install muffler and graphite seal ring. Before assembling graphite seal ring, inspect it for damage. Replace it if necessary.

6) Install exhaust manifold heat protector upper and lower assembly, install ground harness at the same time.

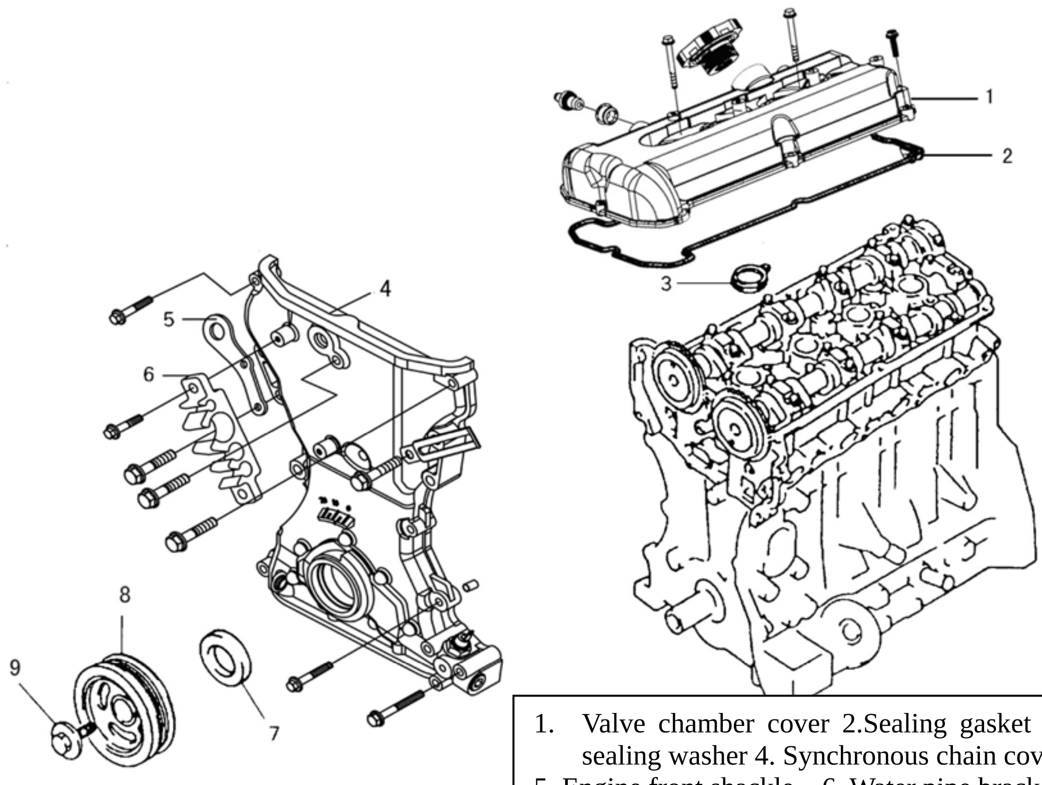
7) connect oxygen sensor

8) connect the cathode of battery.

9) Refill the coolant, refer to relative chapter.

10) Start engine and inspect coolant and exhaust system for leakage.

●SYNCHRONOUS CHAIN COVER ASSY **SHOWN AS FIG. 4-95。**



1. Valve chamber cover 2.Sealing gasket 3.Spark plug sealing washer 4. Synchronous chain cover
5. Engine front shackle 6. Water pipe bracket assy
7.Crank front sealing 8. Crank pulley 9.Crank pulley bolt

Fig.4-95

DISASSEMBLY

1) Remove the multi-wedge belt

2) Remove crank pulley and speed tray assy.

3) Remove oil pan assy.

Refer to “oil pan and oil catcher”

4) Remove valve chamber cover assy.

Refer to “valve chamber cover assy.”.

5) Unscrew bolt on the synchronous chain cover assy. Remove synchronous chain cover assy. Shown as Fig.4-96。

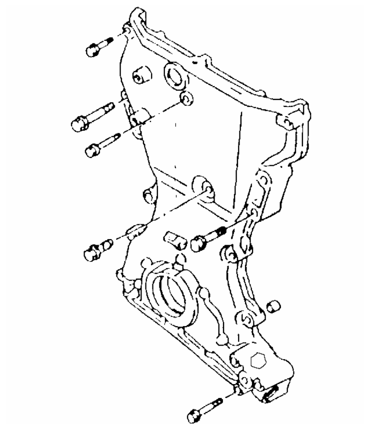


Fig.4-96

ASSEMBLY

Synchronous chain cover assy reassembly is the reverse of synchronous chain cover assy disassembly. but should notice problems as follow:

1) Apply sealant at “A” position shown as Fig. 4-97.

“A”: LETAI 5699

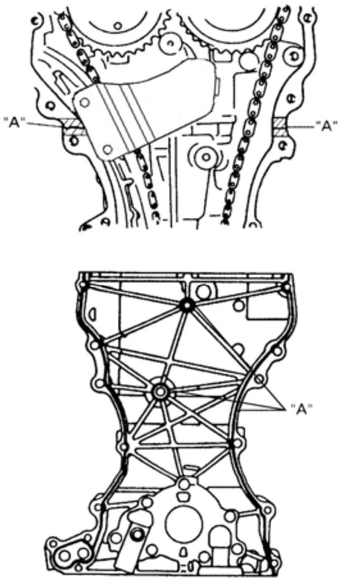


Fig. 4-97

2) apply oil on the lip of oil sealing assy of the synchronous chain cover shell. Then install synchronous chain cover shell assy. Tighten screw to specified torque. Shown as Fig. 4-34,

> NOTICE:
>
> - Inspect reliability of the positioning set pin fit before install synchronous chain cover shell assy.
> - Apply sealant anew while install middle bolt .

"A": HZ1213

Tightening Torque

(a): 11 N • m (M6 bolt)

(b): 23 N • m (M8 bolt)

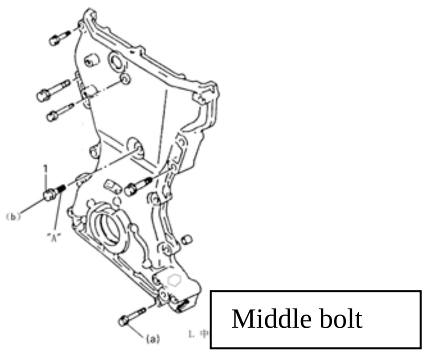


Fig. 4-98

3) Reassemble water pump according to "water pump part" of cooling system

4) Reassemble oil pan and oil catcher according to " oil pan and oil catcher assy."

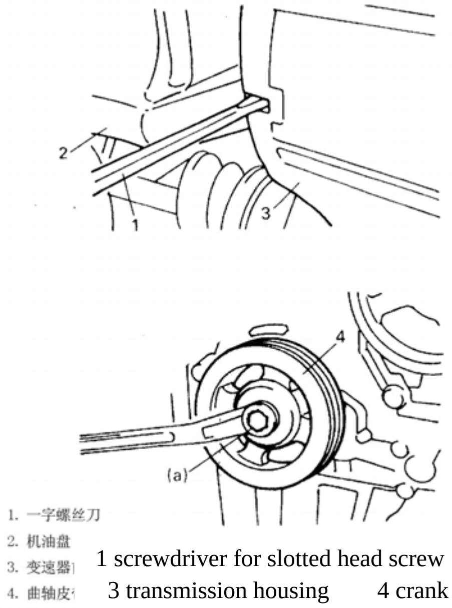
5) Reassemble valve chamber cover assembly according to "valve chamber cover assembly"

6) install crank pulley and speed tray. Then tighten it to specified torque. Shown as Fig. 4-99。

Tightening torque

(a): 115 N • m

(b): 50 N • m



1 screwdriver for slotted head screw 2 oil pan
3 transmission housing 4 crank pulley

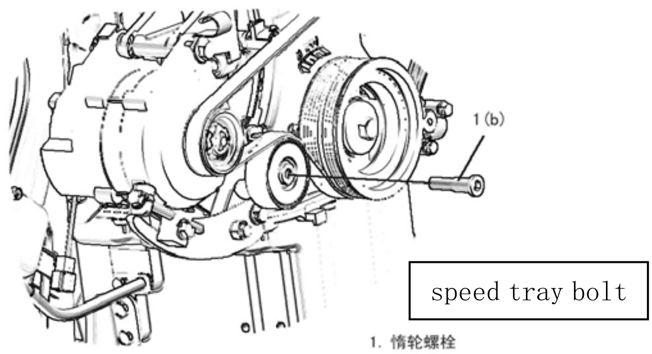


Fig. 4-99

7) Install multi-wedge belt

● TIMING CHAIN AND TENSIONER ADJUSTORas shown in Fig.4-100。

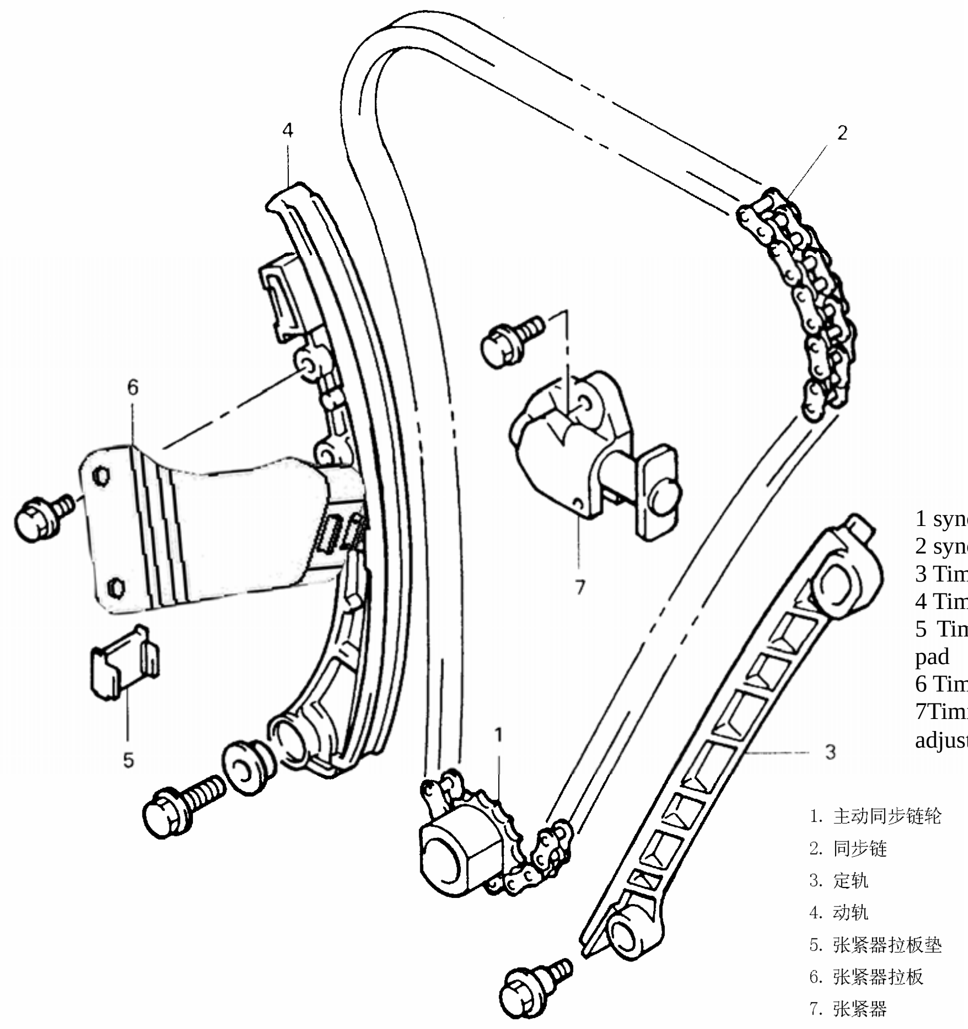


Fig.4-100

Disassembly

1) Remove oil pan and oil catcher assy.
Refer to "oil pan and oil catcher assy"

2) Remove valve chamber cover assy.
Refer to "valve chamber cover assy.".

3) disassemble timing chain assy according to "timing chain assy".

4) Remove the timing chain guide.

5) Remove the timing chain tensioner link.

6) Remove the timing chain tensioner.

7) Remove the timing chain tensioner adjuster.

8)Remove the timing chain assy and drive timing chain pulley.

INSTALL

1) Rotate crankshaft, align the woodruff key with install sign on the cylinder bodyas shown in Fig.4-101。

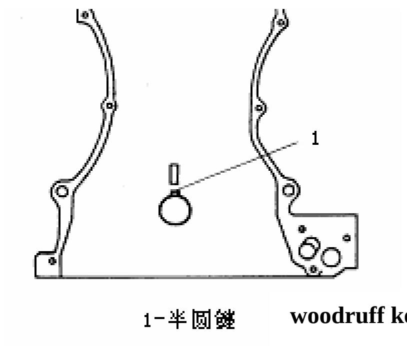
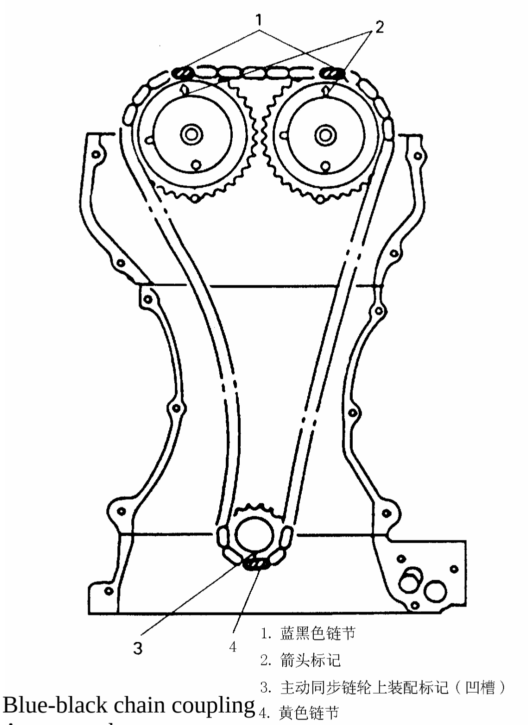


Fig.4-101

2) install synchronous chain assy, the position of blue-black chain coupling and yellow chain coupling mounting as shown Fig.4-102.

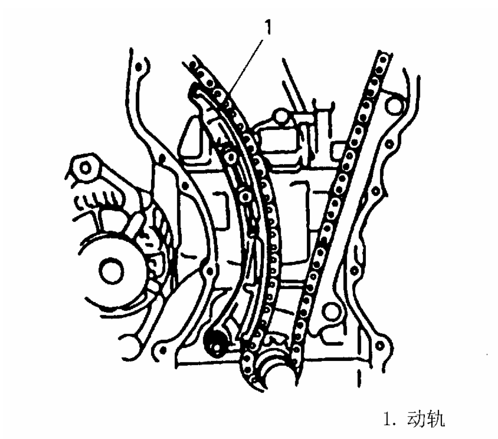


1. Blue-black chain coupling
2. Arrow mark
3. Groove on the initiative chain pulley
4. yellow chain coupling

Fig. 4-102

3) Align the yellow chain coupling on the synchronous chain assy dead with groove on the initiative synchronous pulley, and then install the initiative synchronous pulley to the crankshaft. 4th cylinder is in the top-dead position at this moment.

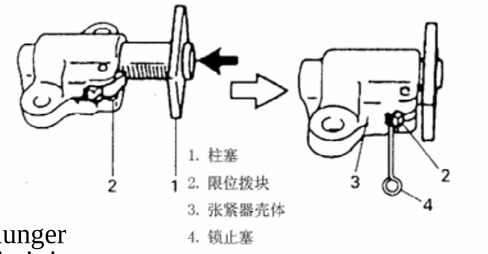
4）Install timing chain tensioner shown as Fig. 4-103



1. Timing chain tensioner

Fig.4-103

5）Open the limiting stopper, press the plungers into timing chain tensioner seat. Make the plunger locked by the limiting stopper, then according to fig. 4-104, insert lock plunger-flakes, insure plunger can’t dap out.



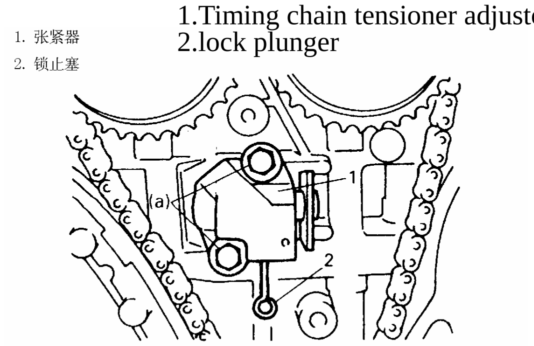
1. Plunger
2. Limitting stopper
3. Timing chain tensioner adjustor shell
4. Lock plunger

Fig. 4-104

6) install tensioner adjustor, shown as Fig. 4-105.

Tightening torque

1.Timing chain tensioner adjustor
2.lock plunger



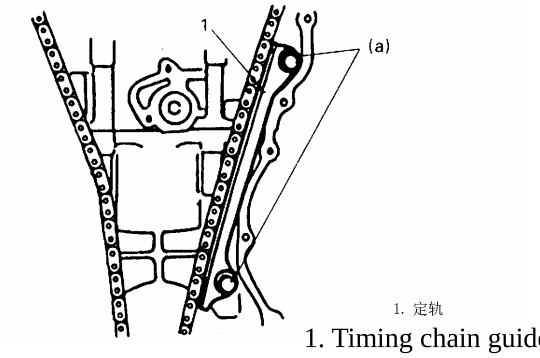
（a）: 11 N•m

Fig. 4-105

7）install timing chain guide as shown in Fig. 4-106。

Tightening torque

（a）: 9 N•m



1. Timing chain guide

Fig. 4-106

8) install timing chain tensioner linkas shown in Fig. Fig. 4-107.

9) pull out lock plunger-flake.

10) install synchronous chain cover assy according to “synchronous chain cover assy”.

11) install valve chamber cover assy according to “valve chamber cover assy.”

12) install oil pan and oil catcher according to “oil pan and oil catcher.”

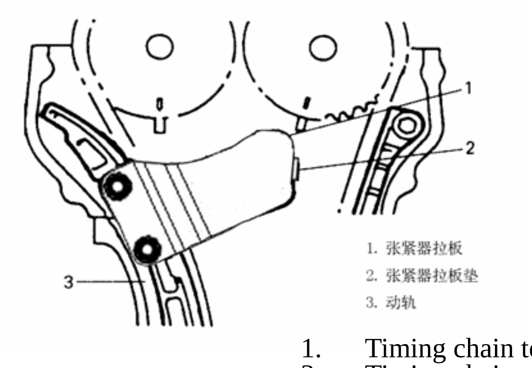
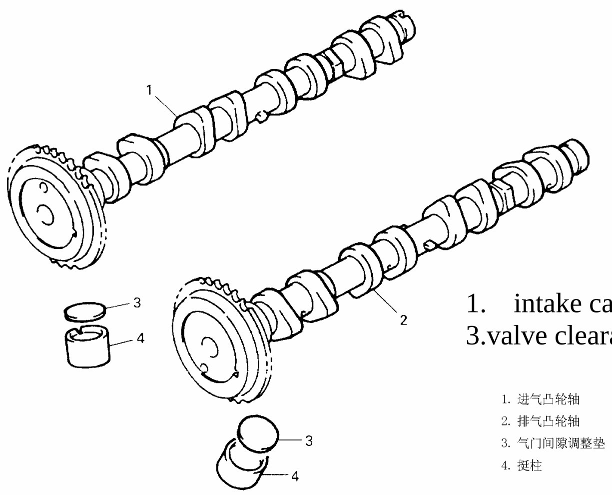


Fig. 4-107

1. Timing chain tensioner link
2. Timing chain tensioner link pad
3. Timing chain tensioner

● CAMSHAFT, TAPPET AND VALVE CLEARANCES ADJUSTMENT GASKET SHOWN AS FIG. 4-108.



1. intake camshaft 2.exhaust camshaft 3.valve clearance adjustment gasket 4.tappet

Fig. 4-108

DISASSEMBLY

1) Remove valve chamber cover assy and oil pan assy refer to the relative chapter.

2) disassemble timing chain cover shell assy according to “timing chain cover shell assy”.

3)disassemble timing chain and tensioner adjustor according to “timing chain and tensioner adjustor”.

4) remove bolt of camshaft bearing cover according to the order as Fig.4-109 shown.

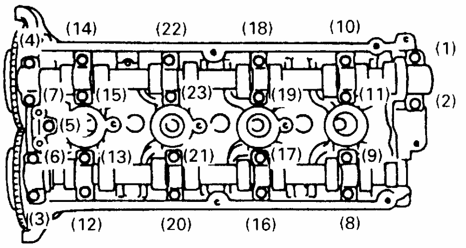


Fig. 4-109

5）remove camshaft bearing cover

6）remove camshaft and crankshaft phase sensor.

7） take out tappet and valve clearance adjustment gasket.

INSTALL

1） Install the tappet and valve lash adjustment gasket on the cylinder cover，，and apply a thin layer of oil around tappet before assemble as shown in Fig. Fig.4-110。

2）Install camshaftas shown in Fig. 4-111。

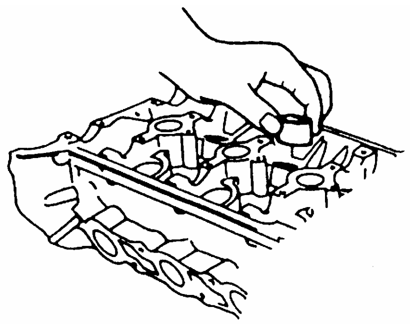


Fig. 4-110

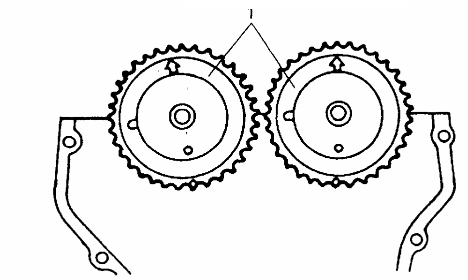
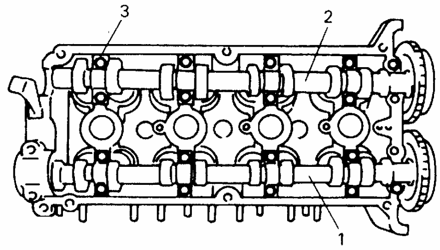


Fig. 4-111

CAUTION：

TURN CRANKSHAFT MAKES HALF CIRCLE BOND UPWARDS BEFORE ASSEMBLING CAMSHAFT.APPLY OIL ON THE CAMSHAFT SURFACE ， AXLE NECK AND CAMSHAFT BEARING HOLE。



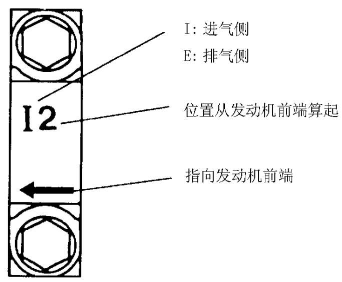
1. inlet camshaft
2. exhaust camshaft
3. positing set

3） Install camshaft bearing cover’s locating bush ， shown as Fig 4-112 Fig.4-112.

4） inspect the position of camshaft bearing cover. Install camshaft-bearing cover according to the mark and position of each camshaft bearing cover.

5） Coat plane sealed glue on the rear end cover of intake camshaft as shown in Fig. 4-113.

“A”：oil-proof silicon ketone sealant HZ1213



1. Intake side
2. Exhaust side

Position from engine front end

Toward engine front end

Fig.4-113

6） After apply oil to bearing cover bolt，fix bolt first， then tighten bolt according to number order as shown in Fig.4-114，tighten it 2 or 3 times to reach specified torque.

Tighten torque：11N•m

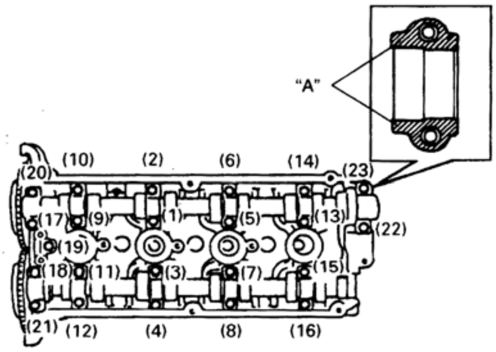


Fig.4-114

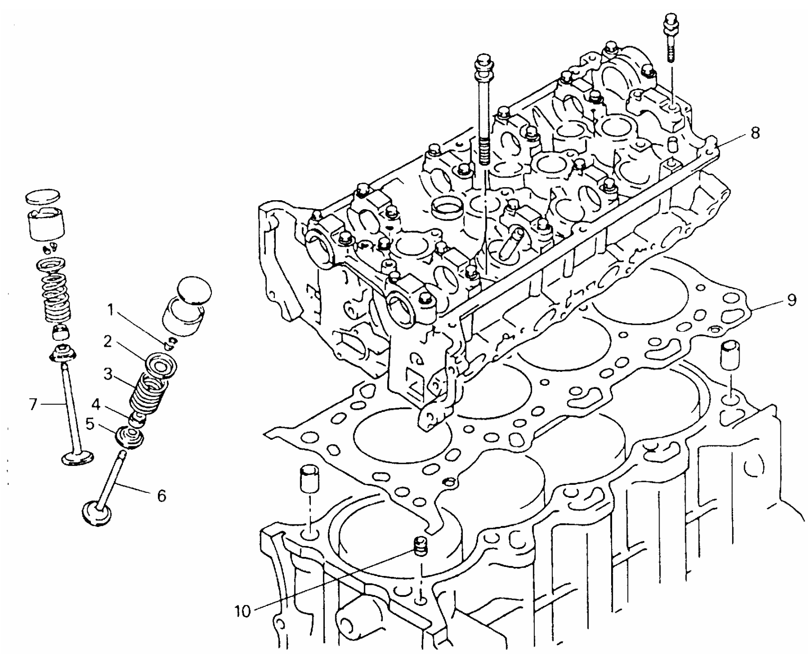
7) Install timing chain and tensioning pulley refer to "timing chain and tensioner adjustor".

8) Install timing chain cover assy according to "timing chain cover assy".

9) inspect the valve clearance refer to the method as previously outlined.

10) Install valve chamber cover assy and oil pan assy refer to the method as previously outlined.

● VALVE AND CYLINDER HEAD AS SHOWN IN Fig.4-115



1. Valve circlip
2. Spring seat
3. Valve spring
4. Valve oil sealing
5. Spring washer
6. Exhaust valve
7. Intake valve
8. Cylinderhead
9. Cylinder gasket
10. Tthrottle valve

1. 气门卡簧
2. 弹簧座
3. 气门弹簧
4. 气门油封
5. 弹簧垫圈
6. 排气门
7. 进气门
8. 气缸盖
9. 气缸垫
10. 节流咀

Fig. 4-115

Removal

1) Remove valve chamber cover assy according to “valve chamber cover assy”.

2) Remove timing chain assy according to “timing chain assy”.

3) Remove camshaft, tappet and valve clearance adjusting gasket according to “camshaft, tappet and valve clearance adjusting gasket” as shown in Fig.4-116。

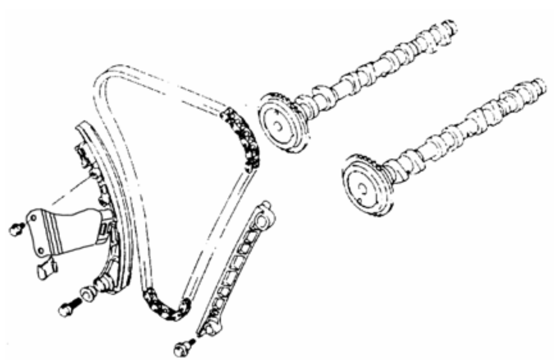


Fig.4-116

4) Remove cylinder head bolt according to order as shown in Fig.4-117.

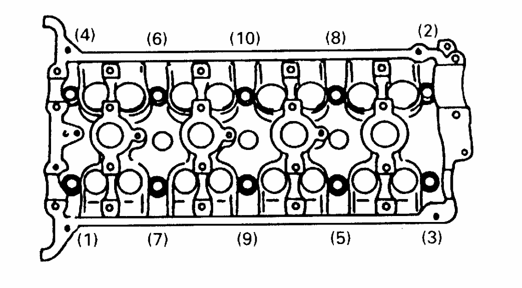


Fig.4-117

5) inspect other components connected with cylinder head, disassemble them when necessary.

6) Remove the cylinder head, intake manifold and exhaust manifold.

DISASSEMBLY

1) Disassemble exhaust manifold and intake manifold with throttle body assy from cylinder head for convenient to inspect and repair cylinder head easy.

2) Take down tappet and valve clearance adjustment gasket refor to the method related previously.

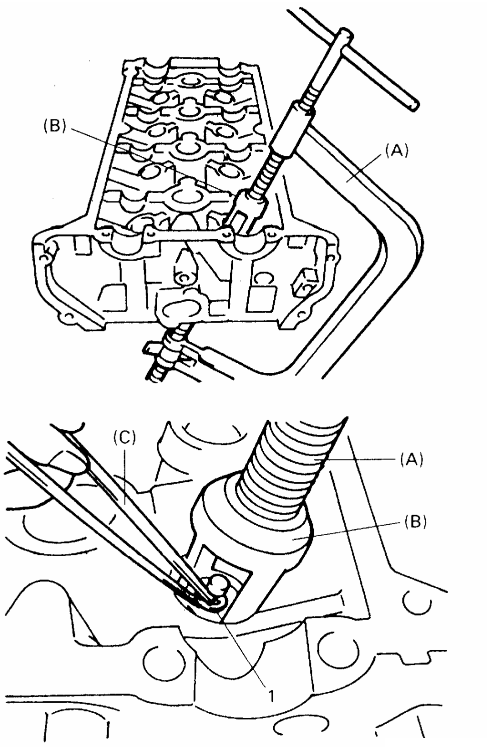
3) Press valve spring with special tool, then take out valve circlip with special tool(forceps) as shown in Fig.4-118.

Special tool:

(A): valve lifter;

(B): valve lifter adjunct;

(C): forceps



1. 气门卡簧 1.Valve circlip

Fig.4-118

4) Remove special tools, take down valve spring seat and valve spring.

5) take out valve from combustion chamber side.

6)Remove valve oil seal from valve guide, then take down valve spring gasket as shown in Fig4-119.

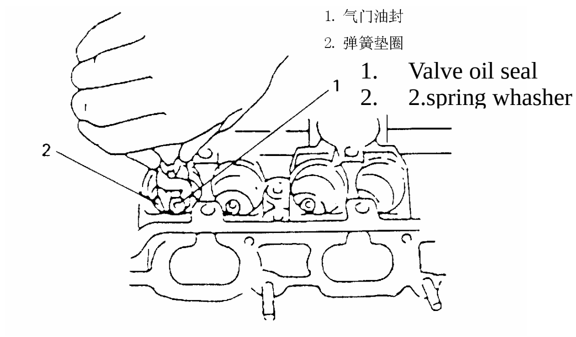


Fig. 4-119

NOTICE:

BE SURE THAT THE VALVE OIL SEAL MUST BE REPLACED WHEN ASSEMBLING AND THE OLD CANNOT BE REUSED AGAIN.

7) Place the disassembled parts except valve oil seal in order, so that they can be installed in their original positions.

REASSEMBLY:

1) Install valve spring gasket as shown in Fig. 4-120。

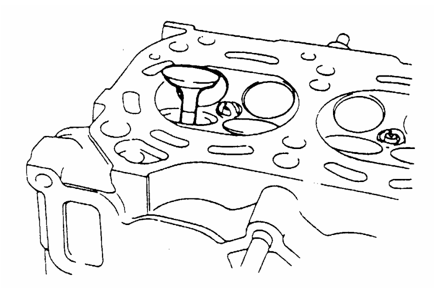


Fig. 4-120

2) Install the new valve oil seal on valve guide as shown in Fig. 4-121。

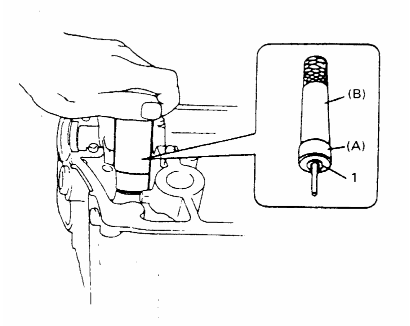


Fig. 4-121

Apply oil on the valve oil seal and the mandrel of the special tool (spanner handle for installing valve oil seal), install oil seal to the mandrel of the special tool, then press the special tool by hand. Install the oil seal to the valve guide. After installing, inspect if valve oil seal be installed to the valve guide.

Special tool:

(A): Valve oil seal assembling tool adjunct

(B): Valve oil seal assembling tool

CAUTION:

- DO NOT REUSE THE VALVE OIL SEAL DISASSEMBLED. BE SURE TO USE THE NEW ONE WHEN ASSEMBLING
- ONLY PRESSING SPECIAL TOOL BY HAND TO INSTALL VALVE OIL SEAL IS PERMITED, DON'T KNOCK THE SPECIAL TOOL BY HAMMER OR OTHER TOOL WHEN ASSEMBLING IN ORDER TO AVOID DAMAGE THE VALVE OIL SEAL.

3) Install valve on valve guide

Apply engine oil on valve oil seal、valve guide inner hole and valve stem before assembling valve to valve guide.

4) Install valve spring and top valve spring seat as shown in Fig. 4-122.

Each valve spring has top(big screw distance end-color mark) and bottom(small screw distance end). Be sure than the spring bottom(small screw distance end) face adown(spring washer end).

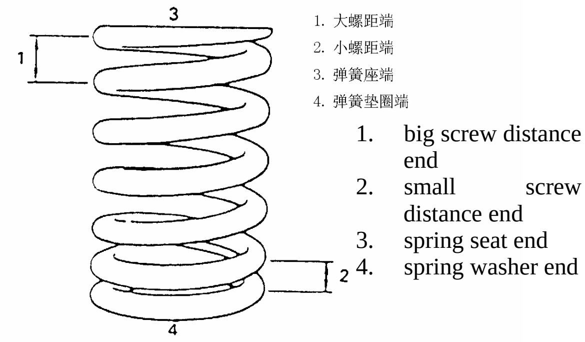


Fig. 4-122

5) Press valve spring by special tool, install two valve circlips to the groove of the valve stem as shown in Fig. 4-123.

Special tool:

(A): Valve lifter

(B): Valve lifter adjunct

(C): Forceps

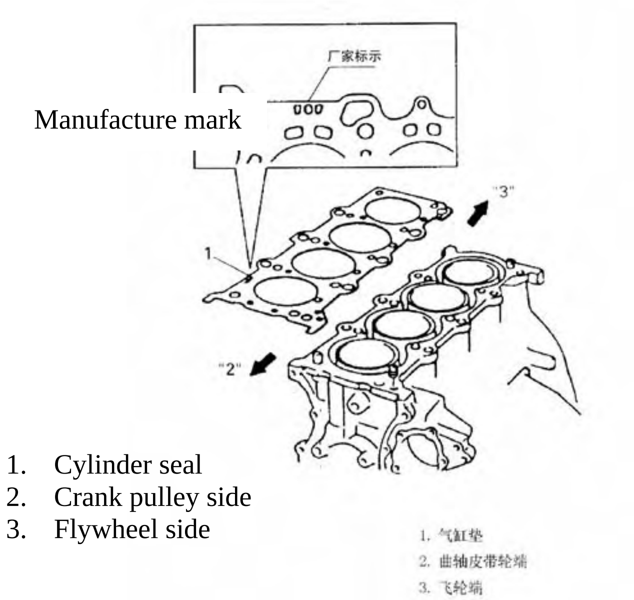


Fig. 4-123

6) Install intake manifold assy and exhaust manifold.

● CYLINDER HEAD

1) Remove old cylinder head gasket, wipe off the smear on the joint surface, install a new cylinder gasket refer to Fig. 4-124. That means the "top" surface of marked on the side toward crankshaft pulley (toward cylinder cover)

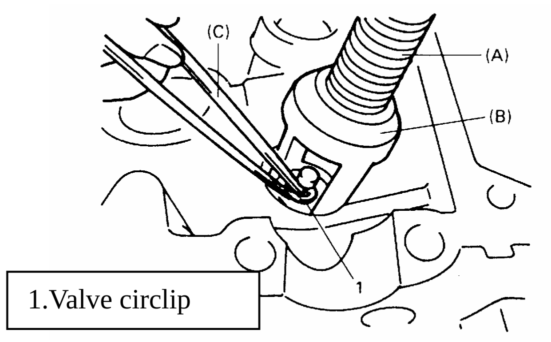


Fig. 4-124

CAUTION

DO NOT REUSE THE VALVE GASKETDISASSEMBLED. BE SURE TO USE NEW CYLINDER GASKET WHEN ASSEMBING.

2) Inspect throttle valve installing, insure it isn't walled up as shown in Fig. 4-125. Tighten it according to specified torque.

Tightening torque:

(a): 5 N • m

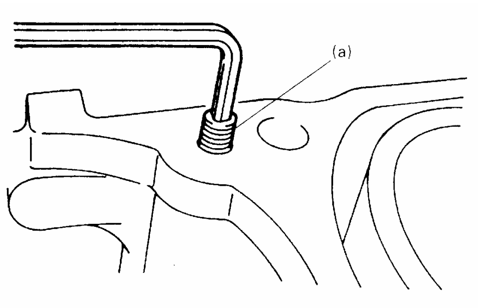


Fig. 4-125

3) Apply engine oil round the cylinder head bolts, tighten in order according to request as follow (Fig. 4-126)

(1) Tighten all bolts with 40 N • m (4.0kg • m) torque in order as shown in Fig.

(2) Loosen all bolts with 40 N • m (4.0kg • m) torque in reverse order as shown in Fig.

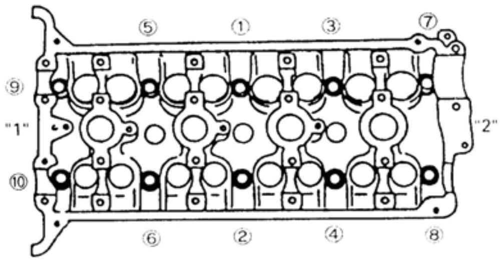
(3) Tighten all bolts with 25～30 N • m (2.5～

3.0kg • m）torque at the same mode（1）.

（5）Tighten all bolts to specified torque at the same mode of （1）.

Tightening torque

（a)：55～60 N • m



1. Camshaft chain end
2. The rear end of engine

1. 凸轮轴链轮端
2. 发动机后端

Fig. 4-126

4）install camshaft , camshaft bearing cover, phase sensor, synchronous chain assy, timing chain tensioner, timing chain tensioner link, timing chain tensioner adjustor, initiative synchronous chain, timing chain guide according to the mention front.

5）install synchronous chain cover assy.

Refer to “synchronous chain cover assy” install it.

6）install valve chamber cover assy.

Refer to “valve chamber cover assy.” install it.

7）Install oil pan assy.

Refer to the content about lubrication system.

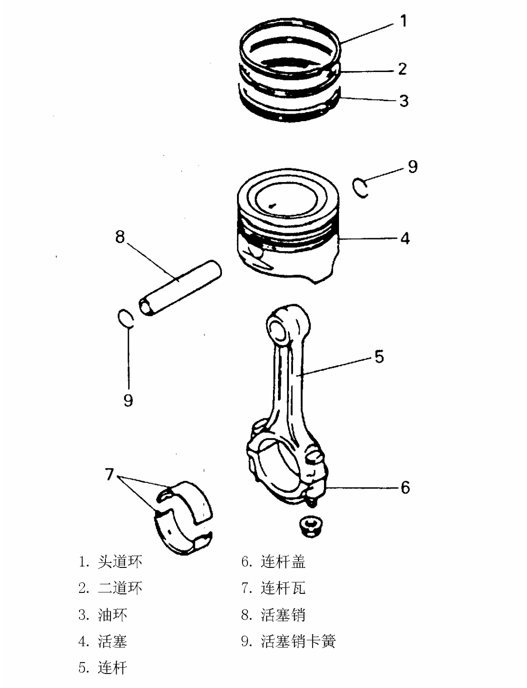
● PISTON、PISTON RING、CONNECTING ROD AND CYLINDER BUSH AS SHOWN IN Fig. 4-127

Removal

1）drain off engine oil.

2）disassemble oil pan and oil strainer as previously outlined.

3）Remove cylinder head from cylinder body as previously oustlined.



1. The first ring　　6. Connecting rod cover
2. The second ring　　7. Connecting rod gear shell
3. Oil ring　　8. Piston pin
4. Piston　　9. Piston pin circlip
5. Connecting rod

Fig. 4-127

4）mark cylinder number on all pistons 、connecting rod and connecting rod cover with silvery white pencil or quick dry lacquer.

5）Remove connecting rod cover.

6）Install connecting rod guide bush to the connecting rod bolt screw thread in order to prove crank pin and connecting rod bolt screw thread damaged as shown in Fig.4-128.

7）clean out carbon deposit from top of cylinder bush before disassemble piston from cylinder body.

8）push out piston and connecting rod assy from the top of cylinder bush.

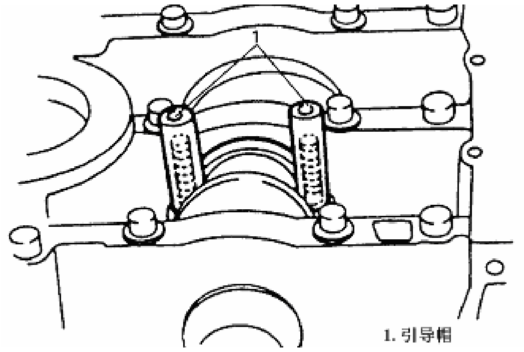


Fig. 4-128

引导帽：Guide cap

Disassembly

1）Remove two compress ring (the first ring and the second ring) and oil ring.

3）Remove piston pin from connecting rod. Remove piston pin circlip as shown in Fig. 4-129.

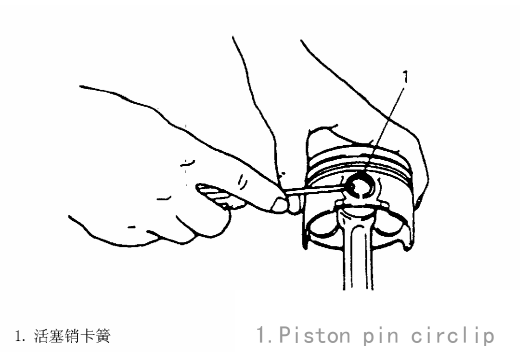


Fig. 4-129

Push out piston pin as shown in Fig. Fig. 4-130。

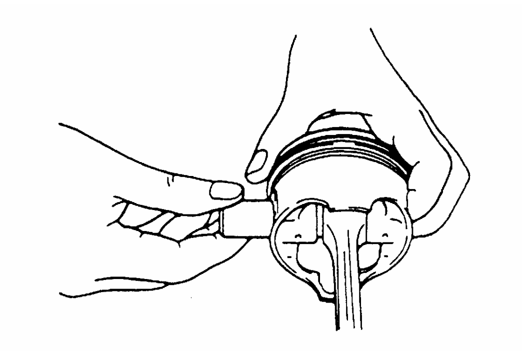


Fig. 4-130

ASSEMBLE

NOTICE：

CHOOSE TWO KINDS OF PISTON IN ORDER TO INSURE CORRECT CLEARANCE BETWEEN PISTON AND CYLINDER AS STANDARD SIZE PART.

BE SURE ASSORTING OF PISTON AND CYLINDER ACCORD WITH AS FOLLOW WHEN INSTALLING STANDARD PISTON:

a）THERE IS COLOR SIGNS ON EACH PISTON AS SHOWN IN FIG. 4-131， INDICATE OUTER DIAMETER OF PISTON.

b）THERE IS GRADE SIGN ON THE FOUNDED SURFACE OF THE MAIN OIL LINE IN THE CRANKCASE EXHAUST SIDE（“BLUE”“YELLOW”CHINESE CHARACTERS OR COLOR SIGN）， BEGIN FROM CRANKSHAFT PULLEY SIDE, THE FIRST SIGN INDICATE INNER DIAMETER OF THE FIRST CYLINDER, THE SECOND SIGN INDICATE THE SECOND CYLINDER, THE THIRD SIGN INDICATE THE THIRD CYLINDER, THE FOURTH SIGN INDICATE THE FOURTH CYLINDER

C) COLOR SIGN ON THE PISTON SHOULD BE ACCORDANCE WITH SIGN ON THE CYLINDER 。IN OTHER WORDS, THE PISTON WITH BLUE SIGN GO TOGETHER THE CYLINDER WITH BLUE SIGN, THE PISTON WITH YELLOW SIGN GO TOGETHER THE CYLINDER WITH YELLOW SIGN.

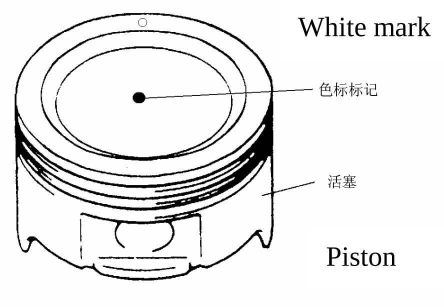
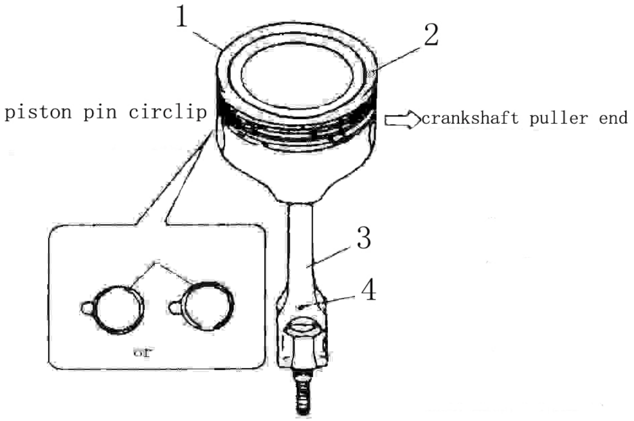


Fig. 4-131

1）Install piston pin to piston and connecting rod.

After applying oil to the piston pin, the hole of piston pin and connecting rod, install connecting rod to the piston as Fig 4-132 shown and insert piston pin into the hole of piston pin and connecting rod, and then install piston pin circlip.



1. Piston
2. Recess sign
3. Connecting rod
4. Oil hole

Oil hole should toward intake side

Fig. 4-132

NOTICE:
WHEN INSTALLING PISTON RETAINER, GROOVE DIRECTION FACE UP OR DOWN AS FIG SHOW.

2) Install piston ring to the piston.

As Fig. 4-133 show, the first and second ring has been marked "RN" "R" separtely. When install piston ring to piston, the side with mark face towards the top of piston.

1. First ring
2. 2.second ring
3. oil ring

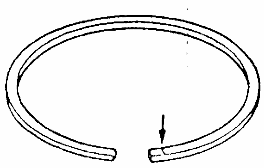
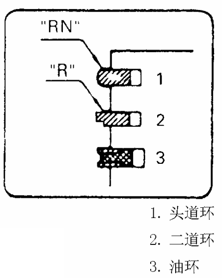



Fig. 4-133

• The thickness, shape and color of touched surface are different between first and second ring.

• Distinguish the 1st ring and the 2nd ring refer to Fig 4-133.

• When installing oil ring , install ripple ring before two scraper oil ring.

• After installing 3 rings(the first ring 、 the second ring and the oil ring), adjust their gap' position as Fig. 4-134 shown.

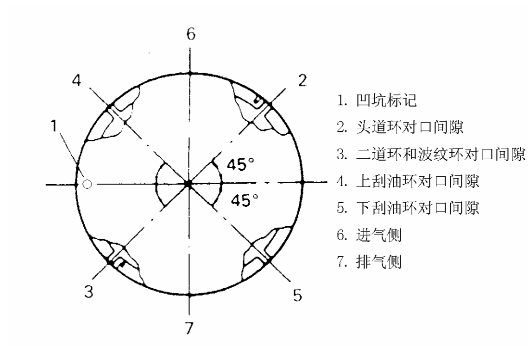


Fig. 4-134

1.Notch mark 2. First ring gap
3. No.2 ring and ripple ring gap
4. Top scraper oil ring gap 5.bottom scraper oil ring gap
6.intake side 7.exhaust side

Installation and Connection

1) Choose connecting rod bearing shell as shown in Table 4-41.

Table 4-41

		The stamped number on crank (Crank pin diameter)		
		1	2	3
The stamped number of matching connecting rod big head hole diameter	1	5	4	3
	2	4	3	2
	3	3	2	1
		The lever of connecting rod		

2）Apply engine oil to piston, piston ring, cylinder wall, connecting rod bearing shell and crank pin.

NOTICE

DON’T APPLY OIL BETWEEN CONNECTING ROD AND CONNECTING ROD BEARING SHELL, CONNECTING ROD COVER AND CONNECTING ROD BEARING SHELL.

3）Install lead cap to connecting rod bolts as shown in Fig.4-135. When Installing connecting rod and piston, these lead cap can prevent thread of crank pin and connecting rod from Being damaged.

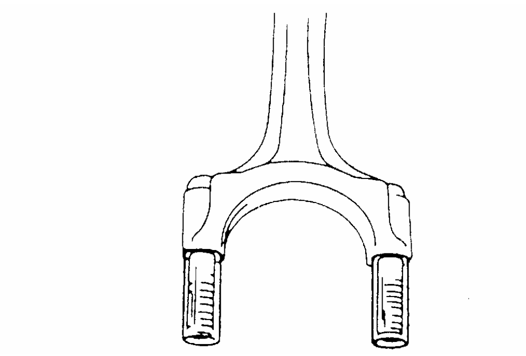


Fig.4-135

4）When installing piston and connecting rod into the cylinder, the concave mark on the piston’s top should face towards crankshaft pulley.

5) Install piston and connecting rod into the cylinder, press piston ring with special tool (Piston ring compressor). Guide the connecting rod into place on the crankshaft. Using a hammer handle to tap the top of piston gently to install the piston into the bore. Hold clamp to make the piston ring against cylinder firmly, till the piston ring enter into cylinder fully as shown in Fig.4-136.

Special tool

（A）：Piston ring compressor

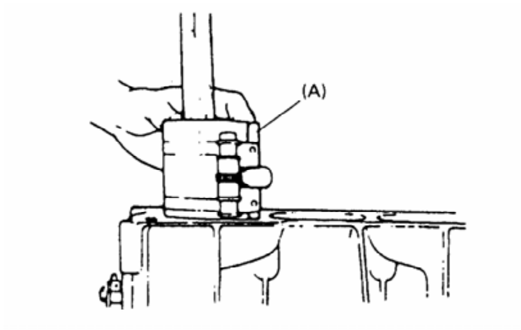
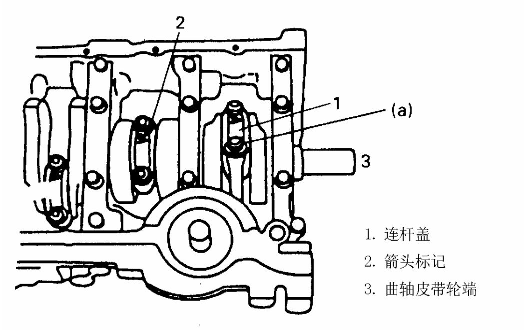


Fig.4-136

6）The cover of connecting rod

Be sure to point the arrow mark on the connecting rod cover to crankshaft pulley as shown in Fig 4-137. Tighten connecting rod nut to the specified torque.

Tightening torque: （a）：33~37 N•m



1.Connecting rod cover 2.arrowhead sign 3.crank pulley side

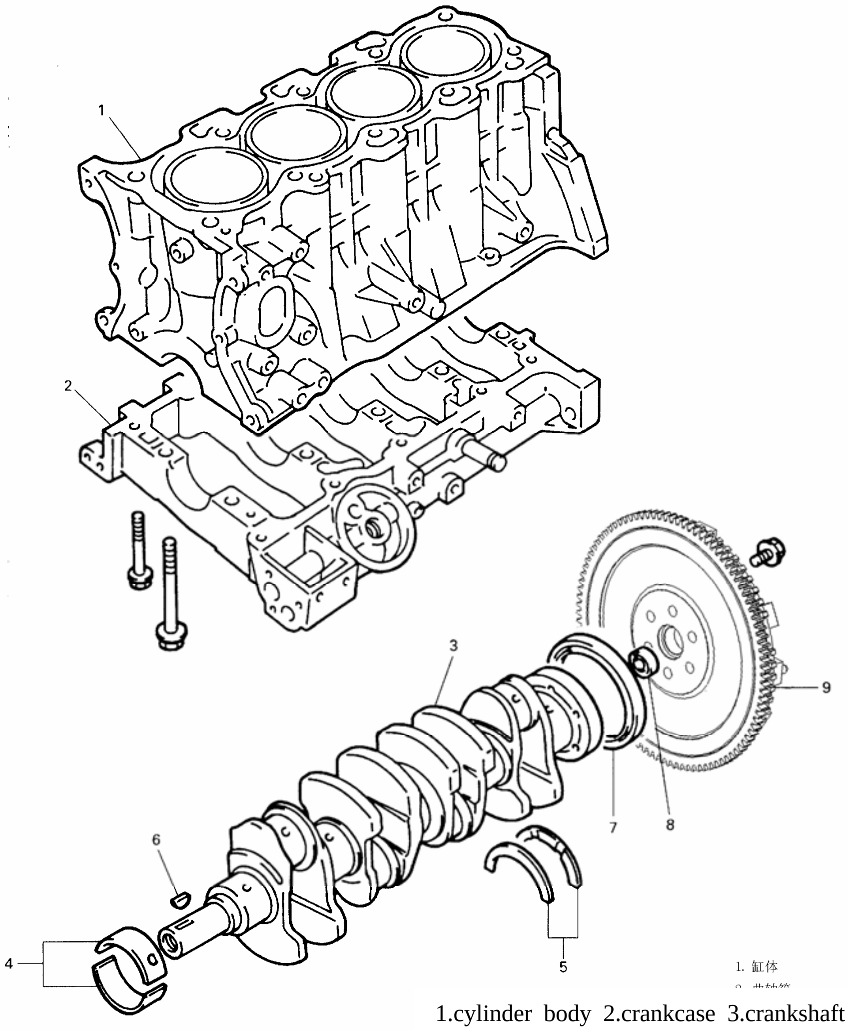
Fig.4-137

7）Reverse the removal procedures for the installation as mentioned previously.

8）Inspect and be sure all the parts disassemble to install the original place, reinstall the necessary missed parts.

● MAIN BEARING BRASS、CRANKSHAFT AND CYLINDER BLOCK

● MAIN BEARING、CRANKSHAFT AND CYLINDER BLOCK AS SHOWN IN FIG**4-138.**



1.cylinder body 2.crankcase 3.crankshaft 4.main bearing shell5.thrust washer 6.woodruff key 7.crankshaft rear seal 8input shaft bearing 9.flywheel

Fig.4-138

Disassemble

1）Disassemble clutch pressure plate, disc and flywheel as shown in Fig.4-139。

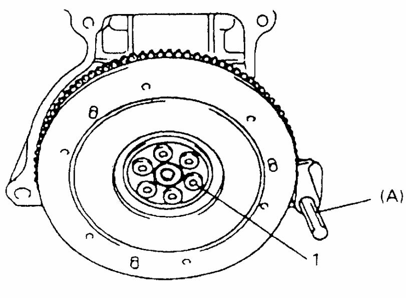


Fig.4-139

special tool:

(A): Flywheel lock tool

2) Disassemble oil pan and catcher assy as mentioned previously.

3) Remove valve chamber cover assy as mentioned previously.

4) Remove timming chain cover shell assy as mentioned previously.

5) Remove timing chain guide, timing chain tensioner, timing chain tensioner adjustor, timing chain tensioner link, initiative synchronous chain pulley as mentioned previously.

6) Remove intake manifold , exhaust manifold and cylinder head assy as mentioned previously.

7) Remove piston and connecting rod assy as mentioned previously..

8) According to the order as shown in Fig. 4-140, lossen crankcase bolts a little every time, disassemble crankcase.

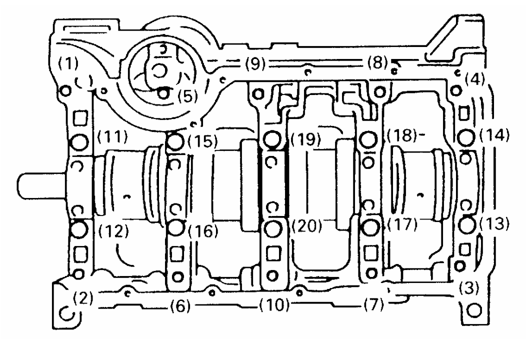


Fig.4-140

9) Disassemble crankshaft from cylinder block.

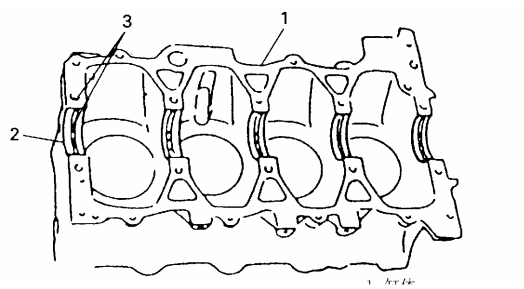
Assembly

NOTICE:

- CLEAN ALL PARTS COMPLETELY BEFORE ASSEMBLING.
- INSURE CRANKSHAFT MAIN BEARING JOURNAL, MAIN BEARING, THRUST PIECE, CRANK PIN, CONNECTING ROD, BEARING SHELL, PISTON, PISTON RING AND CYLINDER ETC TO BE APPLIED OIL TO THE MOVING AREA.
- MAIN BEARING, CONNECTING ROD, CONNECTING ROD BEARING SHELL, CAP OF CONNECTING ROD BIG END, PISTON AND PISTON RING MUST BE ASSEMBLED GROUP BY GROUP. DON' T ASSEMBLE AT WILL。AFTER ASSEMBLING, INSURE EVERY COMPONENT TO BE ASSEMBLED BACK TO ORIGINAL POSITION。

1) Install main bearing to cylinder block.

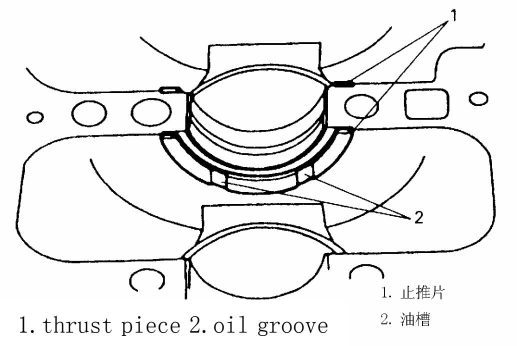
One of two main bearings has a oil groove, assemble it on cylinder block, assemble another on crankcase。Insure two main bearing' s level is same as shown in Fig. 4-141.



1.cylinder body 2.top main bearing brass 3.oil groove

Fig. 4-141

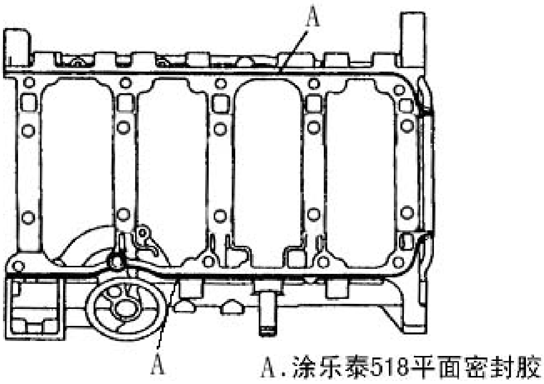
2) Install thrust piece on both side of 2nd and 3rd cylinder wall. Oil groove face match with crank as shown in Fig. 4-142.



1. thrust piece 2. oil groove

Fig. 4-142

3） Install crankshaft to cylinder block.



Apply LETAI 518 plain sealant

Fig.4-143

4） After applying sealant on the matching face of crankcase as shown in Fig.4-143 position “A”, install it to cylinder block.

“A”：LETAI518

Tighten crankcase bolts according to the follow step as shown in Fig.4-144.

（1） Tighten bolts (1) to (10) to 26-30 N•m according to the order.

（2） Tighten bolts (11) to (20) to 10-13 N•m according to the order.

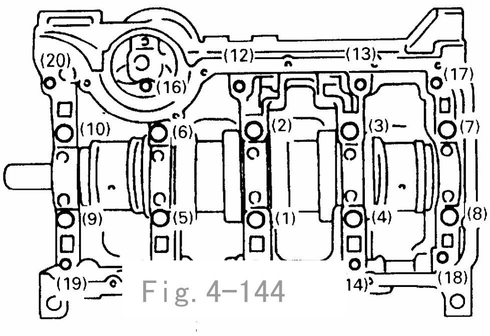


Fig. 4-144

（3） Tighten bolts to specified torque same as item(1).

（4） Tighten bolts to specified torque same as item(2).

Tightening Torque::

From（1）to（10）：53-59 N•m

From（11）to（20）：20-25 N•m

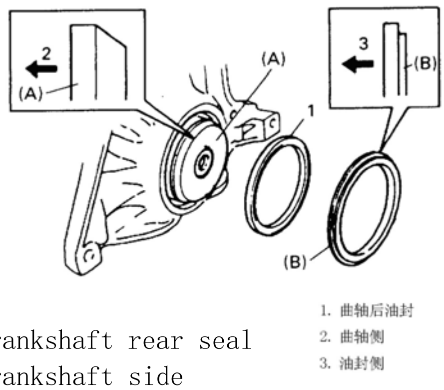
CAUTION：
TURN CRANKSHAFT WITH HAND AFTER TIGHTENING CRANKCASE BOLTS，INSPECT AND INSURE CRANKSHAFT WORK SMOOTHLY

5） Install crankshaft rear seal. Press rear it into cylinder block with special tool as shown in Fig. 4-145.

Special tool:

（A）：Oil seal guide tool

（B）：Oil seal installing tool



1. crankshaft rear seal
2. crankshaft side
3. oil seal side

Fig. 4-145

6）Install flywheel

Lock flywheel with special tool，tighten bolts according to specified torque，apply LETAI 243 anaerobic glue as shown in Fig.4-146.

Special tool

（A）：Flywheel locking tool

Tighten Torque:

（a)：65.5~72.5 N•m

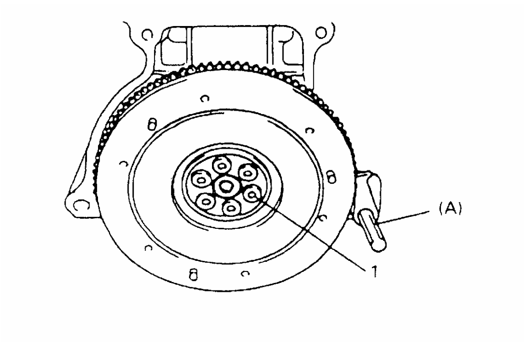


Fig.4-146

7）Install piston and connecting rod assy as mentioned previously.

8）Install cylinder head to cylinder block as mentioned previously.

9) Install camshaft, initiative synchronous chain pulley, synchronous chain assy, synchronous chain cover shell assy, valve chamber cover assy and water pump etc as mentioned previously.

10) Install oil pan and oil catcher as mentioned previously.

11）Install clutch to flywheel tray.

12）Install transmission to engine assy

4.3.6 Engine servicing

CAUTION

•WHEN DISASSEMBLING AND AFTER DISASSEMBLING，CHECK CYLINDER BLOCK AND CYLINDER COVER FOR LEAKAGE OR DAMAGE，CHECK IT CAREFULLY AFTER CLEANING。

• CLEAN ALL DISASSEMBLED PARTS，GET RID OF GREASE、DIRT、CARBON DEPOSIT AND RUST, THEN CHECK IT AND JUDGE WHETHER NEED TO REPAIRED。

• THE RUST IN JACKET MUST BE CLEANED.

• BLOW INNER OIL HOLE AND PASSAGE WITH COMPRESS AIR。

• DON’T DISARRANGE VALVES, BEARING BUSH AND BEARING COVER IN SET，PLACE THEM DIVIDUALLY AND MAKE MARK。

●Timing chain cover assy

1）Cleaning

• Clean timing chain cover assy, crankcase, cylinder body and seal surface of cylinder head。

Clean the oil, sealant and dust on the seal surface.

2）Inspection

• Check cover seal’s lip for damage，replace new one if necessary，Fig 4-147。

CAUTION：

WHEN INSTALLING NEW COVER SHELL OIL SEAL ASSY，PRESS ITS SURFACE AT THE SAME LEVEL AS TIMING CHAIN COVER WITH SPECIAL TOOL。

Special tool

(a)：Bearing assembling tool

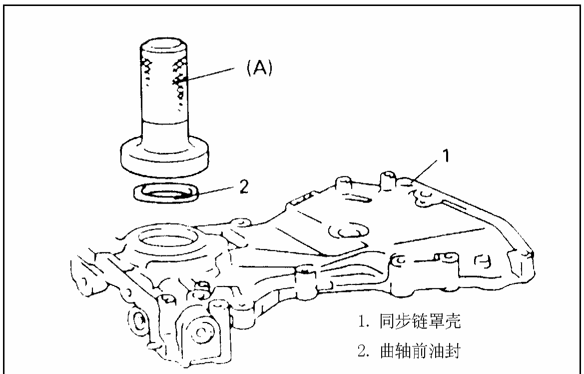


Fig. 4-147

同步链罩壳：

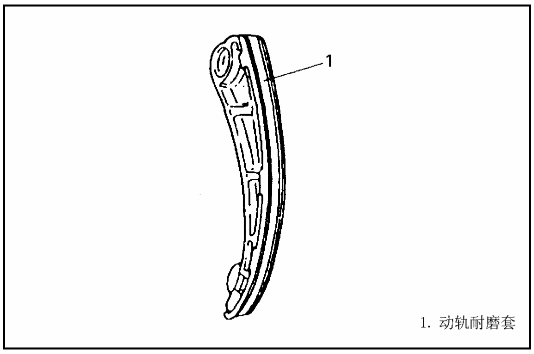
● Timing chain and tensioning assy

• Timing chain tensioner and timing chain tensioner shoe

Check timing chain tensioner shoe for wear and damage Fig.4-148。

• Drive synchronous belt pulley

Check drive synchronous belt pulley for wear and damage，fig.4-149。



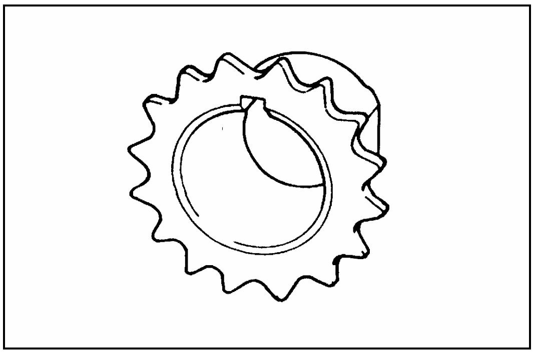


Fig.4-148 fig.4-149

1. Timing chain tensioner shoe

• Timing chain assy

Check the timing chain whether wear and damage.Fig.4-150.

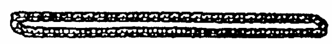


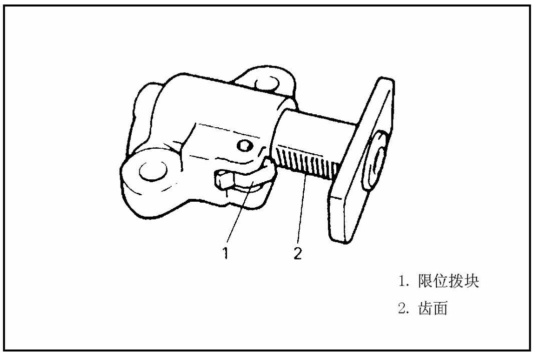
Fig.4-150

• Tensioner assy

Check limiting stopper and toothed surface for damage , check function of limiting stopper ,fig.4-151.

• Timing chain guide

Check timing chain guide for wear and damage, fig.4-152.



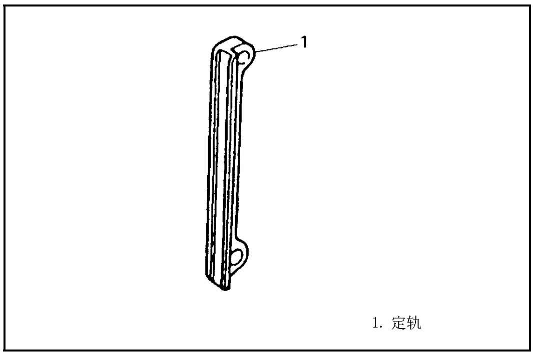


Fig.4-151 fig.4-152

1. Limiting stopper 2. Toothed ring 1. Timing chain guide

● Camshaft 、tappet and adjusting gasket of valve clearance

Inspection

• Camshaft surface wear

Measure camshaft surface with micrometer , if the value is lower than the limited value , replace camshaft, fig.4-153.　　　　　　　　　　　　　　　　　　　　　　　　table 4-42

Camshaft surface height	standard	limit
Intake and exhaust cam（mm）	38.06~38.22	37.93
Fuel pump drive cam（mm）	37.90~38.06	37.77

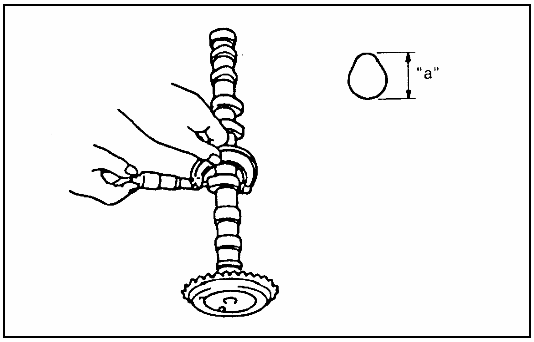


Fig.4-153

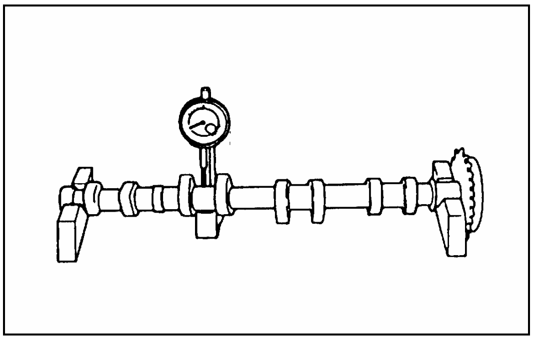


fig.4-154

•Camshaft run out

Place camshaft into the locating groove of "V" type block, measure spherical run out of each journal with micrometer, Replace camshaft if the run out is out of limit.fig.4-154

Axle neck run out limit: 0.1mm

•Wear of camshaft axle journal

1) Check camshaft axle and bearing cover for cavitations, scratching, wear and damage。

If find them abnormally, replace them。Camshaft bearing cover must be replaced with cylinder cover together.fig.4-155

2) Check clearance of camshaft bearing with plastic gauge, check step as follows:

(1) cleaning camshaft bearing hole and axle journal 。

(2) take out tappet and valve clearance adjusting gasket together。

(3) install camshaft to cylinder cover。

(4) place a plastic gauge flake which has same width as camshaft axle neck on the camshaft axle journal along the direction of the camshaft 。

(5) Install camshaft bearing cover.

(6) According to the sequence in fig.4-156, tighten screw of camshaft bearing cover little each time, untill reach to the specified torque value。

CAUTION : NO TURNING CAMSHAFT WHEN OPERATING。

Tighten torque: 11N•m

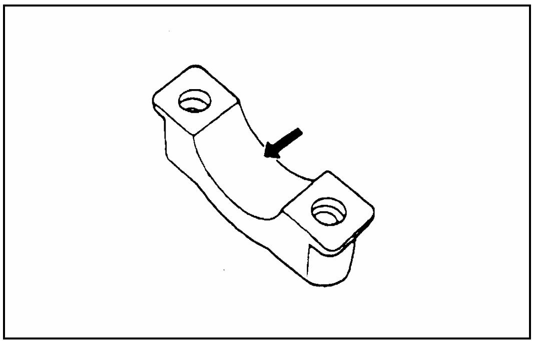


Fig.4-155

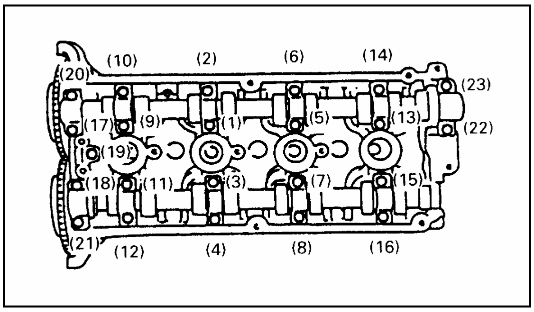


fig.4-156

（7）Disassembly camshaft bearing cover. see fig.4-157, measure arc of staved plastic gauge flake at the widest position，obtain clearance value from graduation of plastic gauge as shown。

table 4-43

	Standard	Limit
Radial clearance（mm）	0.045-0.087	0.12

If measuring clearance of camshaft is out of limit, measure hole diameter of camshaft bearing and diameter of camshaft axle journal。Replace camshaft and cylinder cover which is out of limit，see fig.4-158.

table 4-44

Item	Standard
Hole diameter of camshaft bearing（mm）	23.00-23.021
Diameter of camshaft axle journal（mm）	22.934-22.955

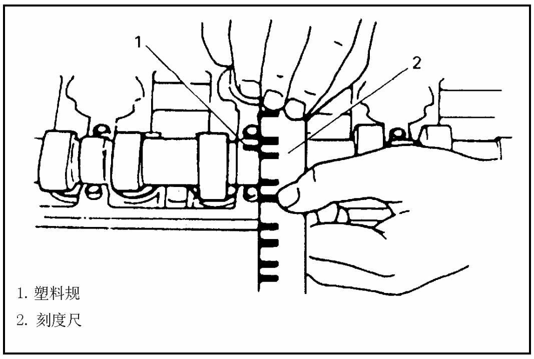


Fig.4-157

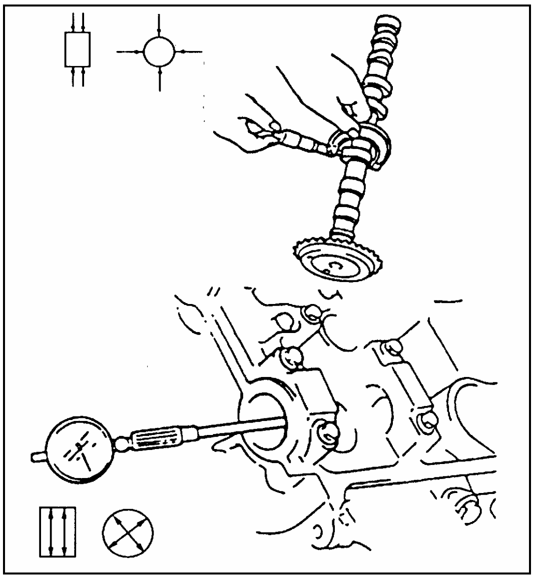


fig.4-158

1.plastic gauge 2. Ruler

• wear of valve clearance adjust gasket and tappet

1) According to position in fig.4-159, check valve clearance gasket and tappet for cavitations, scratched and damaged, replace them if necessary。

2) measure tappet hole diameter of cylinder cover and outside diameter of tappet, if the clearance is out of limit, replace tappet and cylinder cover, see fig.4-160.

table 4-45

Item	Standard value	Limited value
Tappet outer diameter (mm)	26.959-26.975	——
Tappet hole diameter (mm)	27.000-27.021	——
Assort clearance (mm)	0.025-0.062	0.15

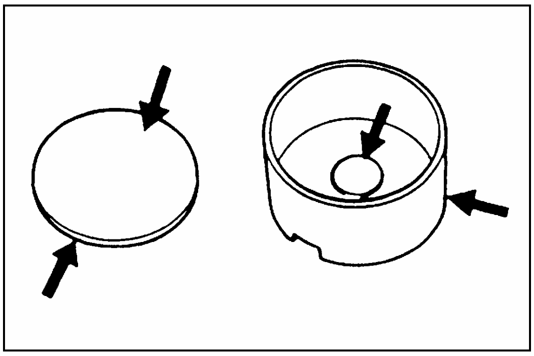


Fig 4-159

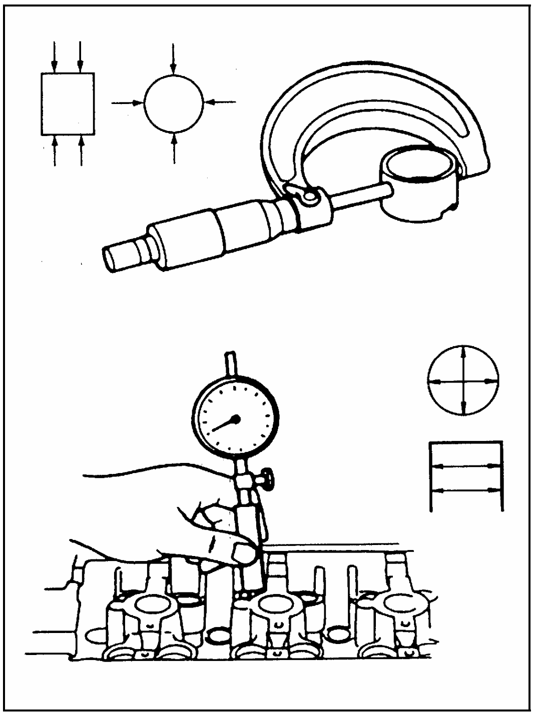


Fig 4-160

● Valve and cylinder cover

Inspection

• valve guide

As Fig 4-161, check valve stem diameter and valve guide inner diameter and inner diameter with micrometer。Check valve stem and valve guide's clearance。The measure point isn't less than two in the direction of length.

If the clearance is beyond limited value, replace valve or cylinder cover。

If inner diameter micrometer can't check inner diameter of valve guide, check variety of

table 4-46

Item		Standard value	Limited value
Valve stem diameter (mm)	Intake	5.465-5.480	——
	Exhaust	5.440-5.455	——
Valve guide inner diameter (mm)	Intake	5.500-5.512	——
	Exhaust		
Assort clearance (mm)	Intake	0.020-0.047	0.07
	Exhaust	0.045-0.072	0.09

Item		Standard value	Limited value
Valve stem diameter (mm)	Intake	5.465-5.480	——
	Exhaust	5.440-5.455	——
Valve guide inner diameter (mm)	Intake	5.500-5.512	——
	Exhaust		
Assort clearance (mm)	Intake	0.020-0.047	0.07
	Exhaust	0.045-0.072	0.09

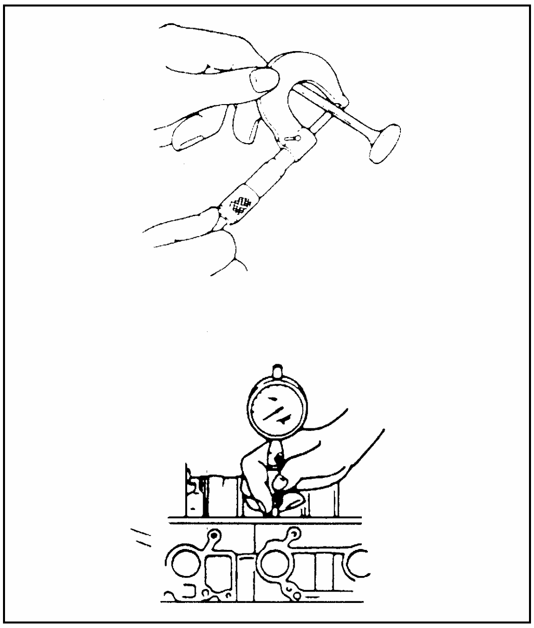


Fig.4-161

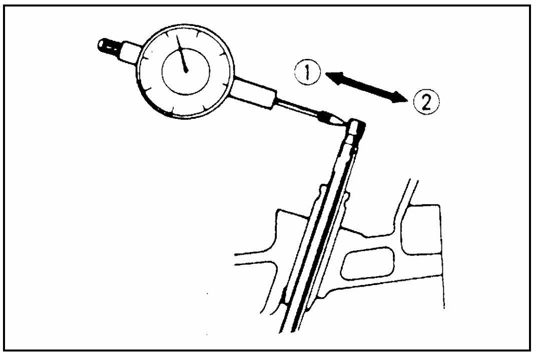


fig.4-162

according to the direction in fig.4-162shown, move valve stem end between ① and ②, measure movement capacity of valve stem end 。If movement capacity is out of limit, replace valve and valve guide.

table 4-47

Movement capacity of valve stem end limit (mm)	Inlet	0.14
	Outlet	0.18

• valve

1) clean out carbon on the valve。

2) check valve seal surface and valve stem for wear、cavitations or distortion。Replace it if necessary 。

3) as fig.4-163 shown, measure thickness of valve head。If the thickness is out of limit, replace

a new one。

Table 4-48

thickness of valve head (mm)		
	standard	limit
Inlet	1.0	0.7
Outlet	1.5	0.5

4) fig.4-164, check valve stem end surface for cavitations and wear 。If wear and cavitations are found ,valve stem end may skived。But repair capacity can't be out of bend angle area of valve stem end 。If it reach degree of bend angle repaired, must replace a new one。

5) The width of seal adhesive tape, see fig.4-165.

In general, each valve has a interface, namely valve head rotated,continually knock at valve seat, form symmetrical seal area. Seal area must be continuous and its width area must be within stated area。

Table 4-49

The width of seal adhesive tape (mm)	Inlet	2.228~3.428
	Outlet	1.987~3.387

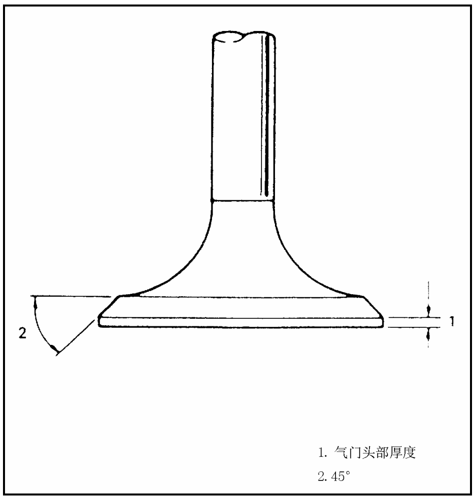


Fig. 4-163

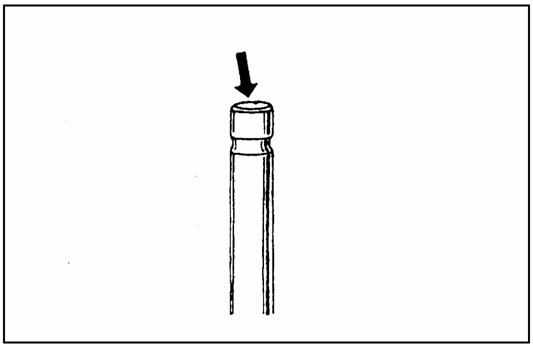


fig. 4-164

1. thickness of valve head
2. 45°

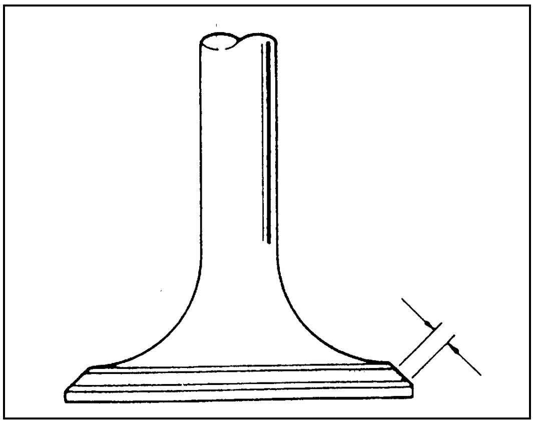


Fig.4-165

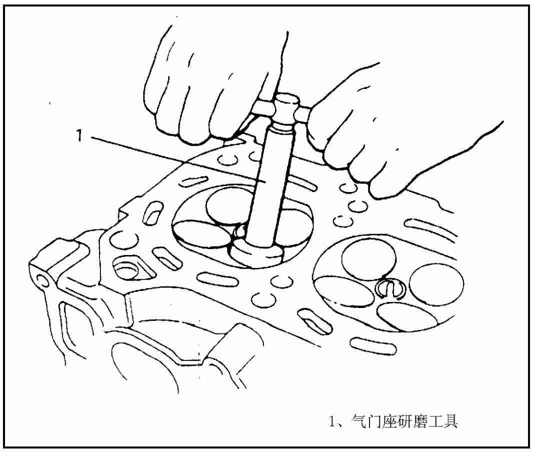


fig.4-166

• valve seat repair

There are not symmetrical seal area between valve seat and valve , Or seal area width is out of limit , need polishing after skiving anew or cutting anew.

1） exhaust valve seat:

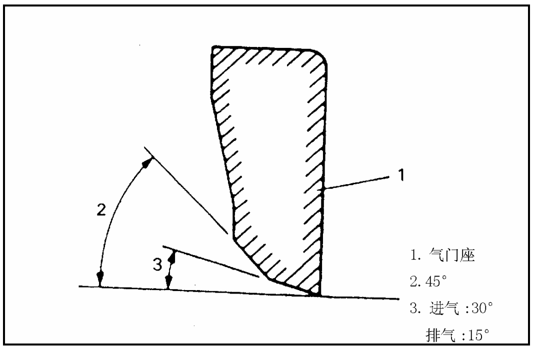
according to fig.4-166, grind valve seat with two skiving tools second time。Valve seat skived angle is 15° with No.1 tool, and it is 45° with No.2 tool。

Valve seat width should be the same as seal area width after No.2 tool skived.

Exhaust valve seat seal area width: 1.214~1.614 mm

2） intake valve seat: according to the repairing sequence of exhaust valve seat to repair .as shown in fig.4-167。But notice that the first skiving angle should be 30° 。

Intake valve seat seal area width: 1.214~1.614 mm



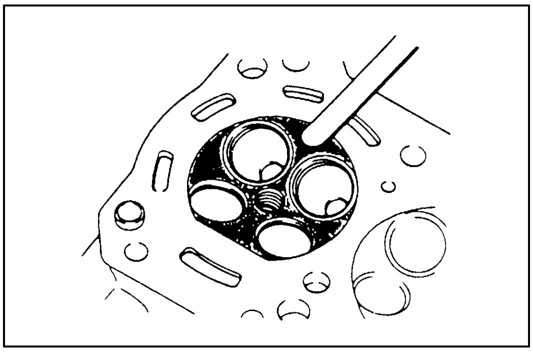


Fig.4-167

fig.4-168

1. Valve seat 2. 45° 3.intake :30 exhaust :15°

2） seal area skiving : Valve and valve seat skiving should be according to step: first step skive with wide, next step skive with thin, each skiving valve with valve beat according to normal order。

• cylinder cover

1） as shown in fig.4-168, clean carbon deposit in the firebox。

CAUTION：

WHEN CLEAR CARBON DEPOSIT ,DON’ T USE TOOLS OF NEEDLE HEAD, IN ORDER TO SCRATCH METAL SURFACE。THE REQUEST IS THE SAME WITH VALVE AND VALVE SEAT CARBON DEPOSIT CLEARING ALSO。

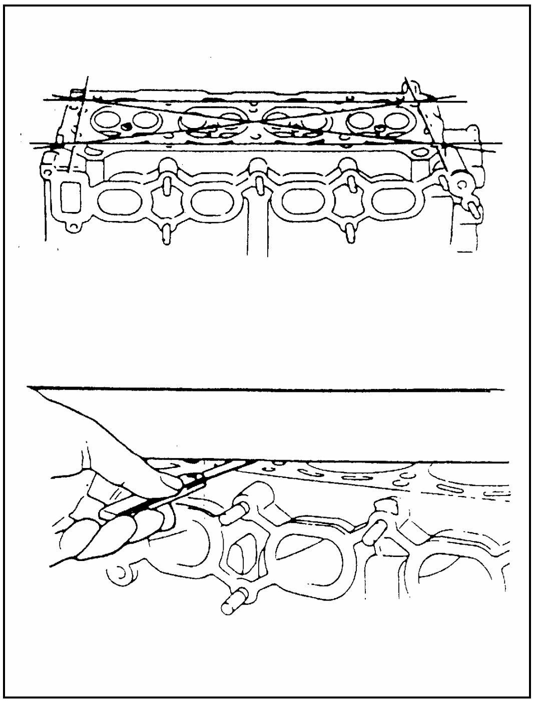


Fig.4-169

2）check inlet and outlet path、combustion chamber and surface of cylinder cover for crack。

3) Planeness of cylinder cover firepower surface:

as fig.4-169, check 6 points on the firepower surface with ruler and plug gauge, if the planeness is out of limit, redress the face with 400# stand paper。If redress is defeated ,replace a new one。

Gas leak from connecting surface of cylinder cover, Often because cylinder cover firepower surface warp, result is lead engine power dropping。

Planeness limit: 0.05mm

4）Planeness of cylinder cover intake and exhaust manifold seal surface:

Check warp of intake and exhaust manifold seal surface on the cylinder cover with ruler and plug gauge, ensure may repair or need replace cylinder cover。

Planeness limit: 0.10mm

• valve spring

valve spring verticality:

According to clearance between valve spring end and ruler, check verticality of valve spring with ruler and plat roof, as fig.4-170。If the clearance is out of limit, replace valve spring 。

valve spring verticality limit: 2.0mm

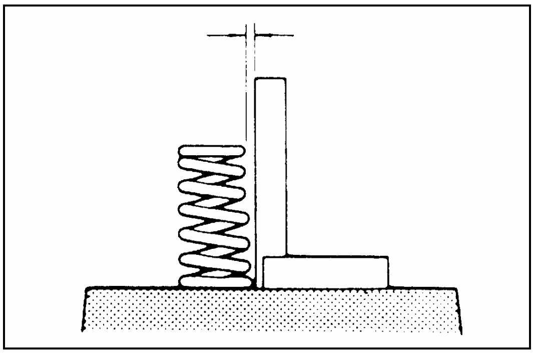


Fig.4-170

● piston 、piston ring、connecting rod and cylinder bush

1.clearing

Clean out carbon deposit on piston top and piston ring groove with special tool。

2.check

•cylinder bush

1) check scratch、coarseness、furrow on the wall of cylinder bush, these indicate cylinder bush if wearied excessively。If inside hole of cylinder bush is very coarse 、deepness scratch or furrow, Cylinder reboring anew and use piston of increased。

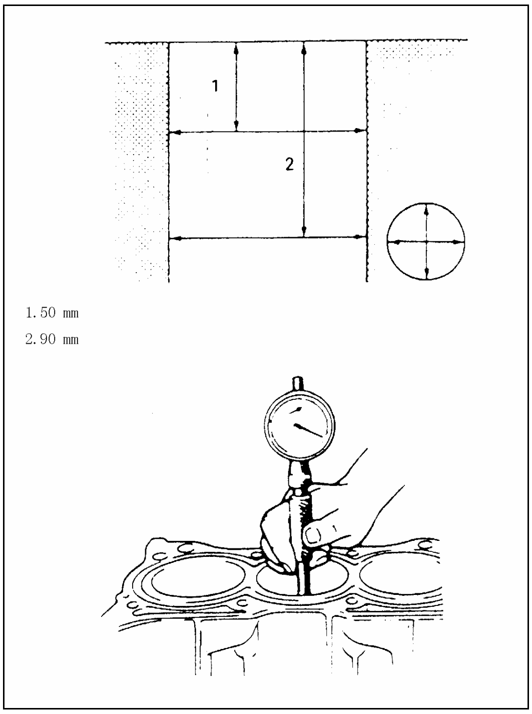


Fig.4-171

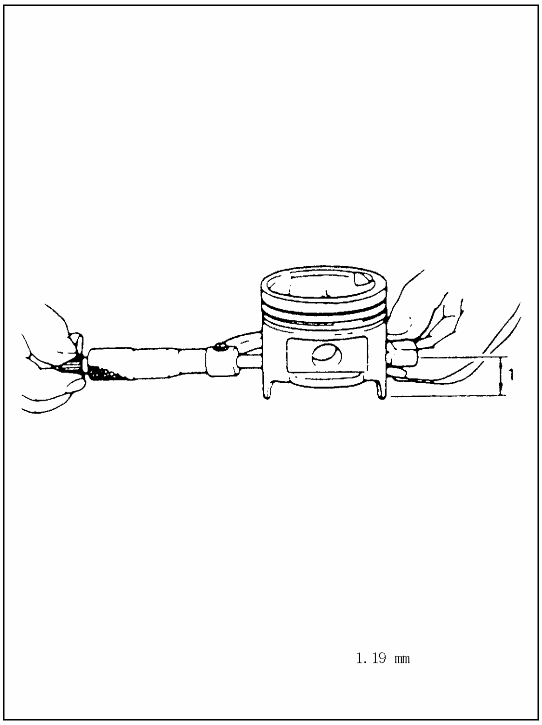


fig.4-172

2) As fig.4-171, respectively measure cylinder dia. at lateral (namely toward thrust surface) and axial with micrometer。

If there is anyone condition as following conditions , must cylinder reboring again 。

A) cylinder bush dia. is out of limit。

B) difference of measuring at two positions is out of conicity limit 。

C) measuring size at lateral and axial is out of ellipse limit。

Cylinder dia. limit：71.070mm

Conicity and ellipse limit：0.10mm

CAUTION：

IF A CYLINDER MUST BE REBORED，THEN FOUR CYLINDERS MUST BE REBORED TOGETHER IN ORDER TO INSURE ENGINE EQUALITY AND BALANCE.

• piston

1） check piston for bug、crack or other damage。Replace if necessary。

2） Piston dia.

As fig.4-172，measure dia. of piston in the vertical direction of piston pin and the position is 19mm away from piston bottom end .

table 4-50

Piston dia.	Standard	70.970~70.990mm
	Increase size：0.25mm	71.220~71.240mm
	0.50mm	71.470~71.490mm

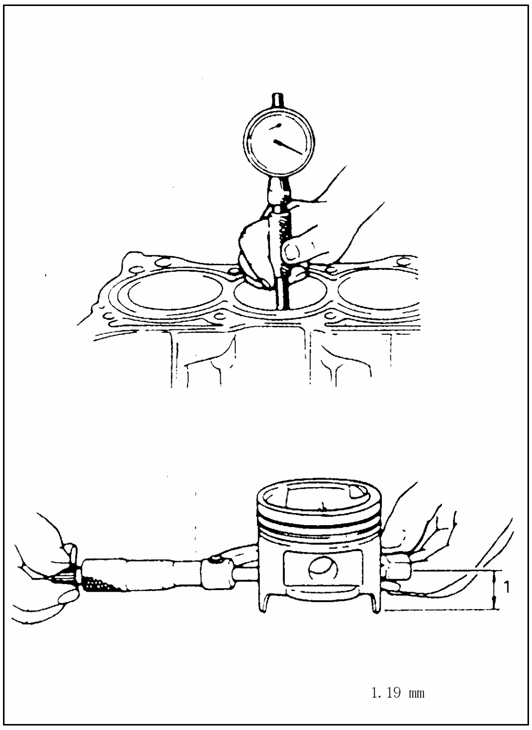


Fig.4-173

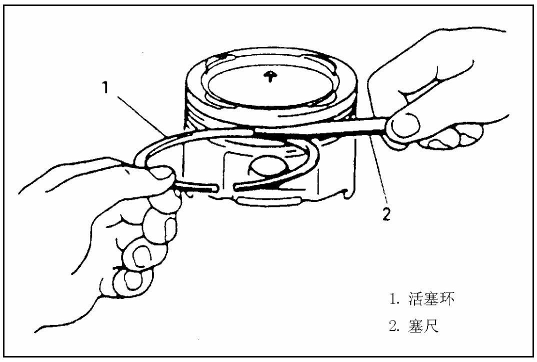


fig.4-174 1.piston ring 2. Plug gauge

3） Clearance of piston and cylinder

As fig.4-173，measure cylinder dia. and piston dia.，the difference of cylinder bush dia.and piston dia. is clearance of them。The clearance of them should be within stated area as follows 。If the clearance is out of limit，reboring cylinder and use increased size piston。

assort clearance of piston：0.02-0.04mm

CAUTION : THIS DIAMETER OF CYLINDER BUSH IS MEASURED WHERE ARE TWO DIFFERENT HIGH POSITIONS TOWARD THRUST SURFACE。

4） ring groove clearance:

Piston ring groove must be clean、dry and no carbon deposit before checking it.

As fig.4-174，put a new piston ring into ring groove，measure clearance between ring and ring bank with plug gauge。If the clearance is out of limit，must replace piston。

Ring groove clearance:

No.1 ring：0.03-0.07mm

No.2 ring ：0.02-0.06mm

Oil ring：0.06-0.15mm

•piston pin

1） Check wear of piston pin、connecting rod small end and hole on the pin，should notice small end bush hole especially。If abrasion or damage of piston pin 、hole of connecting rod small end or piston pin hole are serious ，replace piston pin 、connecting rod or piston。

2） Clearance of piston pin

As fig.4-175，check the clearance between piston pin and connecting rod small end hole，If connecting rod small end is weared or damaged badly，or measuring clearance is out of limit，replace connecting rod。

Table 4-51

item	standard	limit
Clearance of piston pin	0.003-0.016mm	0.05mm

Small end hole dia.: 17.003~17.011 mm

piston pin hole dia.: 17.006~17.014 mm

piston pin dia.: 16.995~17.000 mm

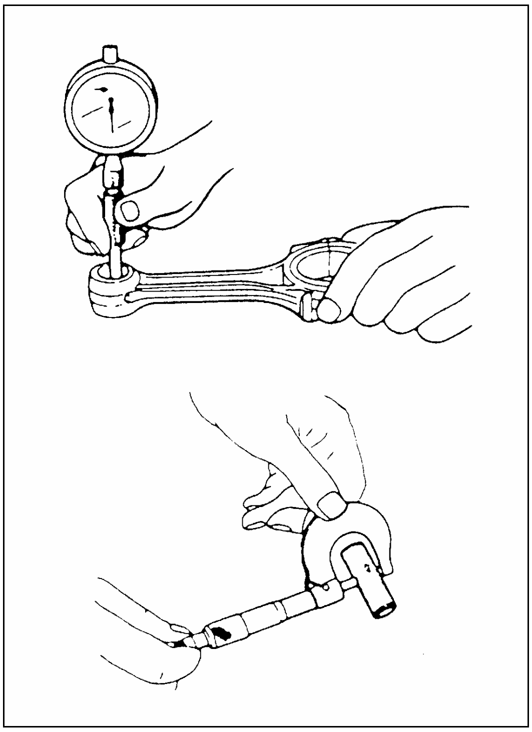


fig.4-175

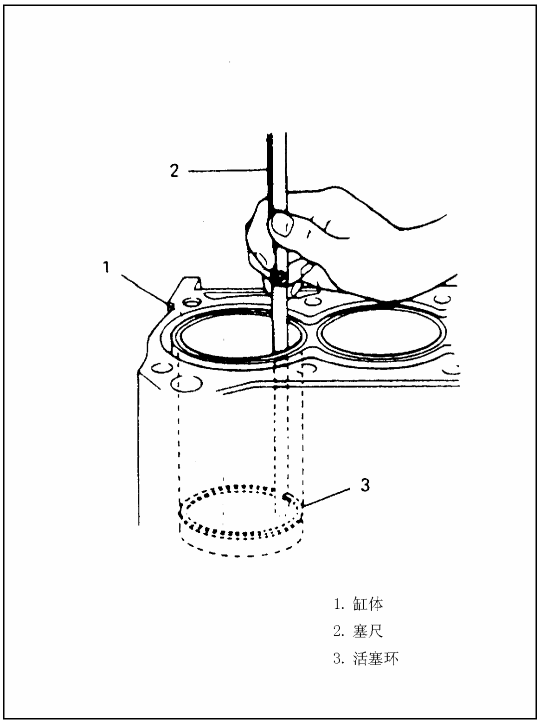


fig.4-176

1.cylinder body 2. plug gauge 3. piston ring

• piston ring

As fig.4-176, measure kerf clearance , put piston ring into cylinder bush , measure the clearance with gauge。

If the clearance is out of limit , replace piston ring 。

CAUTION : CLEAN THE CARBON DEPOSIT ON THE TOP OF CYLINDER BUSH BEFORE PUT PISTON RING INTO CYLINDER BUSH。

Table 4-52

item		standard	limit
clearance of piston ring	No.1 ring	0.15~0.35mm	0.8mm
	No.2 ring	0.30~0.50mm	1.1mm
	Oil ring	0.10~0.40mm	1.6mm

• connecting rod

1） The clearance of connecting rod big end axial

As fig.4-177, in a state of connecting rod is assembled to crank pin, check connecting rod big end axial clearance 。If the clearance is out of limit, replace connecting rod。

Table 4-53

item	standard	limit
Big end axial clearance	0.26-0.49mm	0.53mm

2） connecting rod adjusting :

Install connecting rod to regulator, check its bend and distortion, if they are out of limit , replace it。

Bend limit：0.05mm

Distortion limit：0.10mm

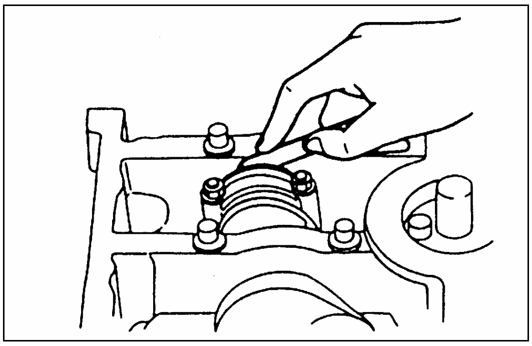


fig.4-177

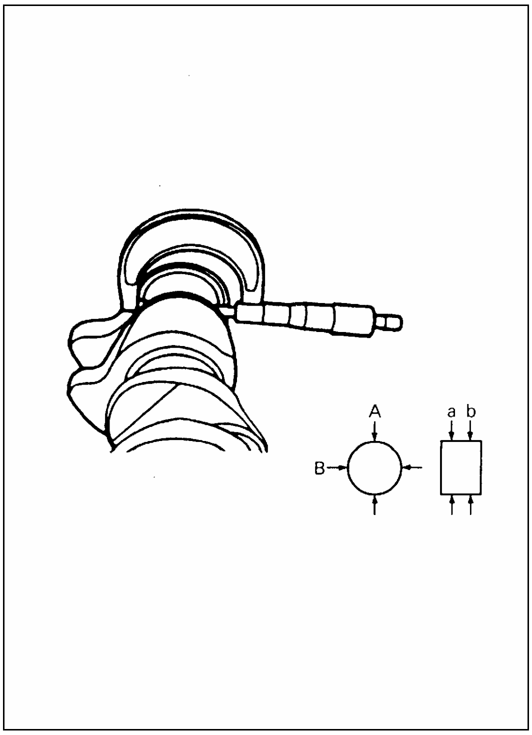


fig.4-178

• Crank pin and connecting rod bearing shell

1） As fig.4-178，check wear and damage of crank pin。Measure cylindricity or conicity of crank pin with micrometer。If crank pin is damaged、cylindricity or conicity are out of limit ,replace crankshaft。Check crank pin and Connecting rod big end diameter.

Table 4-54

mark	size	
	crank pin	Connecting rod big end hole
1	41.994～42.000	45.000～45.006
2	41.988～41.994	45.006～45.012
3	41.982～41.988	45.012～45.018

cylindricity and conicity limit：0.01mm

2）Connecting rod bearing shell

As fig.4-179，check bearing shell melting, hollow, ablation, desquamation. If connecting rod has been damaged, replace it。

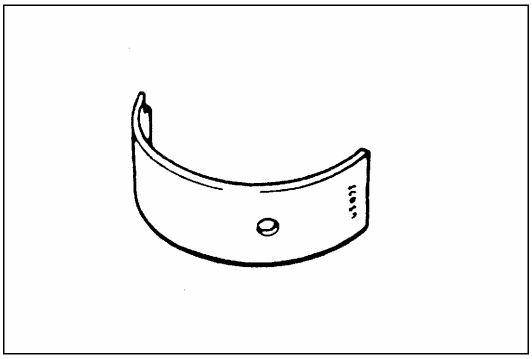


Fig 4-179

Table 4-55

mark	size
0	1.501～1.505
1	1.498～1.502
2	1.495～1.499
3	1.492～1.496
4	1.489～1.493
5	1.486～1.490

3） Clearance of connecting rod bearing shell

A) Before checking the clearance of connecting rod bearing shell，Clean connecting rod bearing shell and crank pin。

B) Install connecting rod bearing shell to the connecting rod and connecting rod cap。

C) As fig 4-180，place a plastic gauge (parallel to the crankshaft)that the length is the same as the width of connecting rod bearing shell. pay attention to avoid the oil path hole。

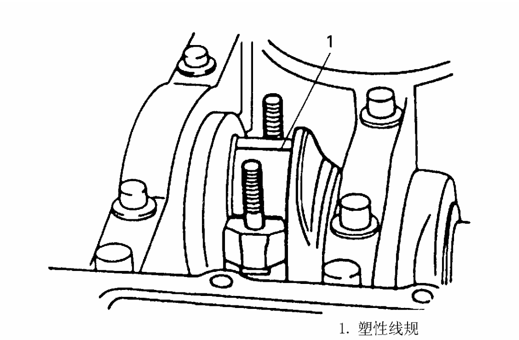
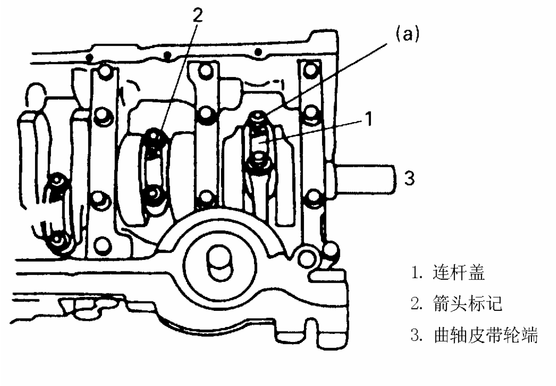


Fig 4-180

1.plastic gauge

D) Install connecting rod cap to connecting rod .

When assembling connecting rod cap，ensure arrow mark on the cap point to crank shaft



1. connecting rod cap 2. arrow mark 3. crank shaft Pulley side

fig.4-181

Pulley。After applying oil to round connecting rod bolt，tighten nut to specified torque，don’t turn the crank shaft after assembling plastic gauge.fig.4-181

Tightening torque

（a)：33-37N•m

E）Disassemble connecting rod cap, measure the maximum width of plastic gauge (clearance) with plastic gauge ruler.fig.4-182

Fig 4-182

1.plastic gauge 2.ruler

If clearance is out of limit, replace a new standard bearing shell and measure clearance again.

Table 4-56

Item	Standard	Limit
Clearance of bearing shell	0.020-0.040mm	0.065mm

●Main bearing shell, crank shaft and cylinder body

Inspection

•crank shaft

1) crank shaft runout:

As fig.4-183, measure runout of main axle spindle central area with micrometer。Run crank shaft slowly, if this runout is out of limit, replace crank shaft 。

Runout limit: 0.04mm.

2) Axial movement of camshaft

Tighten crank case bolts according to the order in fig.4-184.

1) Tighten bolt (1) ~ (10) to the torque of 26~30N•m.

2) Tighten bolt (11) ~ (20) to the torque of 10~13N•m.

3) Tighten bolts according to 1) to specified torque

Tighten bolts according to 2) to specified torque

Tightening torque:

(1) ¬ (10): 53~59 N•m

(11) ¬ (20): 20~25 N•m

Measure axial movement value along crankshaft axial with micrometer。If it is out of limit, replace a new thrust bearing or thicker thrust gasket。

Table 4-57

Item	Standard	Limit
Crankshaft axial movement	0.11-0.31mm	0.35mm

Table 4-58

Crankshaft thrust gasket thickness	Standard	2.500mm
	Increased size:0. 125mm	2.563mm

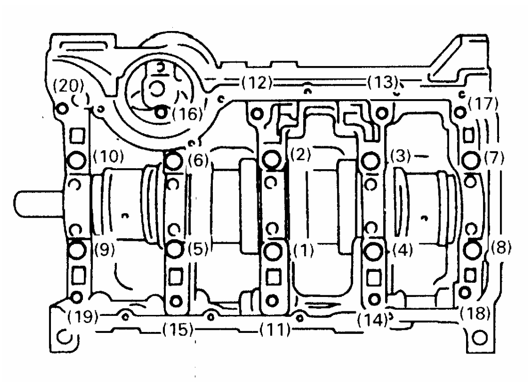


Fig 4-184

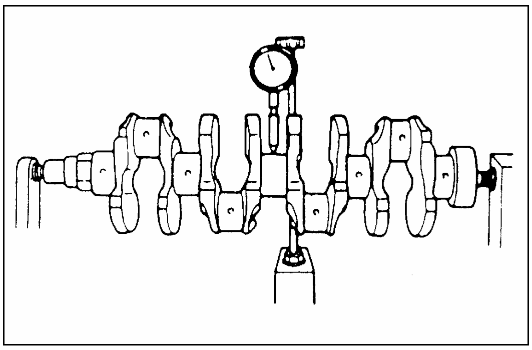


Fig4-183

3）Axle neck’ s cylindericity and conicity(uneven abrasion)

Crankshaft main axle spindle of uneven wear，it is different in diameter of section along axial direction。It can be measured with micrometer，as shown in Fig 4-185.

If the abrasion of any main axle spindle is out of limit, grinding it again or replace crankshaft。

cylindricity and conicity limit：0.01mm

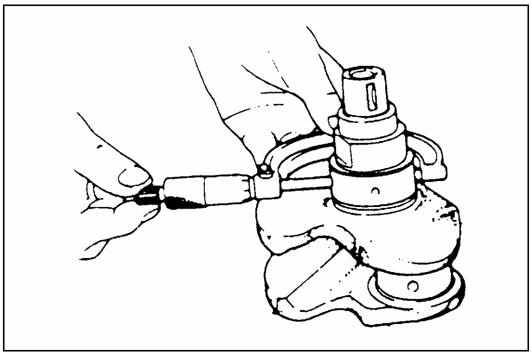


Fig 4-185

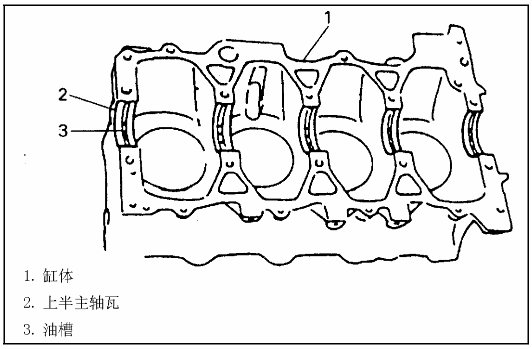


Fig 4-186

1.cylinder block 2.upper main bearing shell

3.oil groove

·main bearing shell

1）General request

As shown in Fig 4-186 upper bearing shell have oil groove。Install the half piece of bearing shell with oil groove to the cylinder block。

2）Inspection

As shown in Fig 4-187，check bearing shell for corrosion, scratch, abrasion and damage。If find abnormal symptom，replace upper bearing shell and lower bearing shell（don’ t replace half piece bearing shell only）.

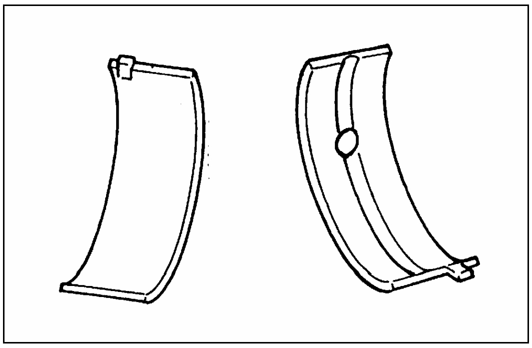


Fig 4-187

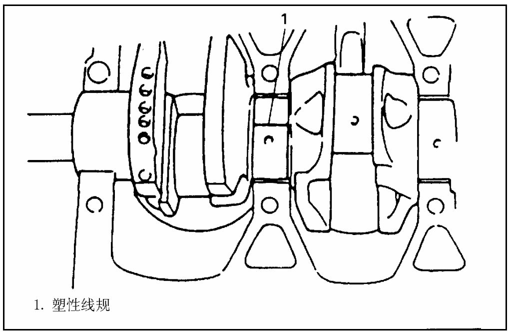


Fig 4-188

1.plastic gauge

3）main bearing shell clearance

As Fig4-188，check clearance with plastic gauge。

（1）crankcase

(2) clean bearing shell and main axle spindle。

(3) Place a piece of plastic gauge which is same length with main axle spindle on the axle spindle(parallel crankshaft), pay attention to avoid oil hole。

(4) Install crankcase referring to "axial movement of crankshaft" section above。

Crankcase must be tightened to specified torque and in correct order, insure the correctness of measuring clearance value, as shown Fig 4-189.

CAUTION:
DON'T TURN CRANKSHAFT AFTER INSTALLING PLASTIC PIECE。

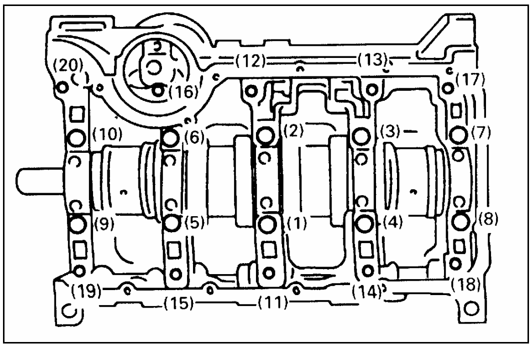


Fig 4-189

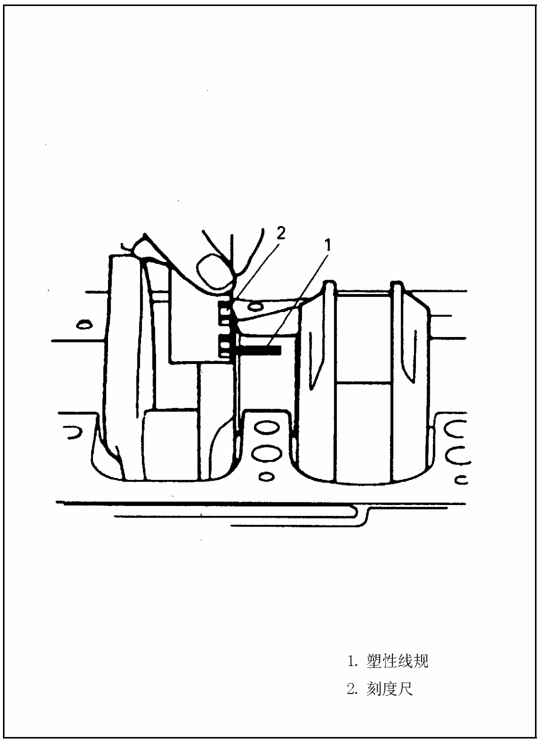


Fig 4-190

1.plastic gauge 2. Ruler

(5) As shown in fig 4-190, disassemble crankcase, measure the width of the plastic gauge shim at the widest area with plastic gauge, if the clearance is out of limit, replace main bearing shell。Upper and lower bearing shell must replace together。

The new shell should have correct clearance (see table 4-17).

After installing new shell, check clearance again。

Table 4-59

Clearance of bearing shell	Standard	Limit
	0.020-0.040mm	0.065mm

4) Select main bearing shell

If main bearing shell's condition is not well or the shell clearance is out of limit, select new shell according to as follow step。

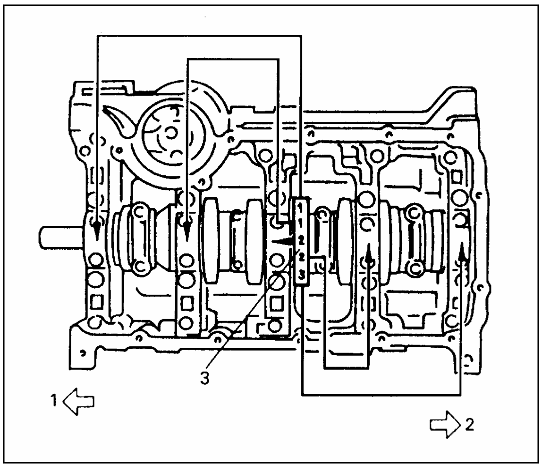
(1) Check main bearing journal diameter as following step。As fig shown, the crank is marked 5 figures on the third cylinder。

The figures is classified into 3 level（“1”、“2”、“3”）indicate the main bearing journal’s diameter below。

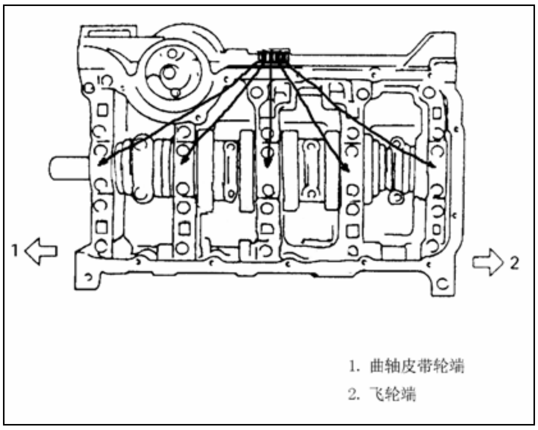
Table 4-60

Mark figure	Main bearing journal diameter
1	44.994-45.000mm
2	44.988-44.994mm
3	44.982-44.988mm

As shown in Fig 4-191，The 1st、2nd、3rd、4th、5th mark figure indicate 5 main bearing journal diameter individually from left to right。For example，in fig，the first（top end）figure “1” indicate（the left end in fig）that corresponding main bearing journal diameter is between 44.994 and 45.000mm。



1.crankshaft pulley end
2.flywheel end 3.crank
Fig 4-191



1.crankshaft pulley end
2.flywheel end
Fig 4-192

（2）Next，check main bearing hole diameter without shell。On crankcase，as Fig 4-126 shown marked with 5 figures。figures is classified into 3 levels（“1”、“2”、“3”），individually indicate main bearing hole diameter as below.fig.4-192

In the Fig ，the mark on crankcase indicate individually the main bearing hole diameter that the arrow point to。For example mark figure “1” indicate that corresponding main bearing hole diameter is 49.000-49.006mm。

（3）Main bearing shell is classified into 6 levels according to thickness。mark position is shown as Fig 4-193。

Every classification mark arrange in table 4-20 indicate main bearing shell centre thickness。

Table 4-61

Classification mark	Main bearing shell thickness
5	1.999-2.003mm
4	2.002-2.006mm
3	2.005-2.009mm
2	2.008-2.012mm

1	2.011-2.015mm
0	2.014-2.018mm

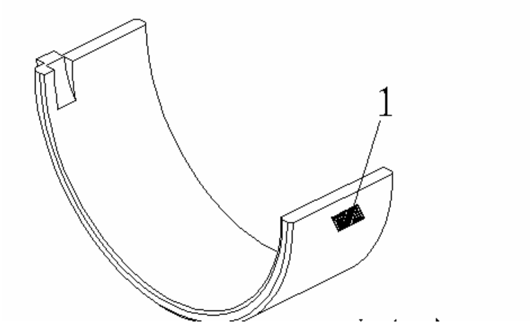


Fig 4-193

1. Classification mark

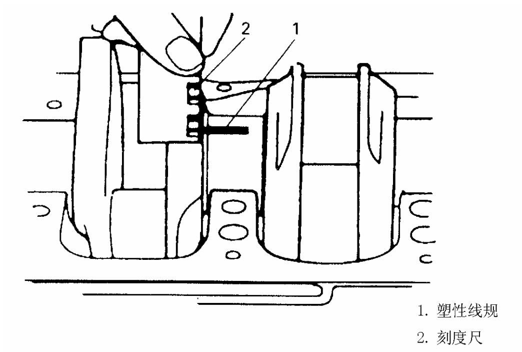


Fig 4-195

1.plastic gauge 2. Ruler

（4）According to table 4-21，determine the level of new assembling main bearing shell by the figure of the third cylinder crank and the figure on the crankcase.fig.4-194

For example，if the figure on crank is “1”，the figure on crankcase is “2”，to assemble 4 level bearing shell。

Table 4-62

		figure mark on crank（main shaft journal diameter）		
		1	2	3
figure mark （main bearing hole diameter）	1	5	4	3
	2	4	3	2
	3	3	2	1
		New bearing shell level		

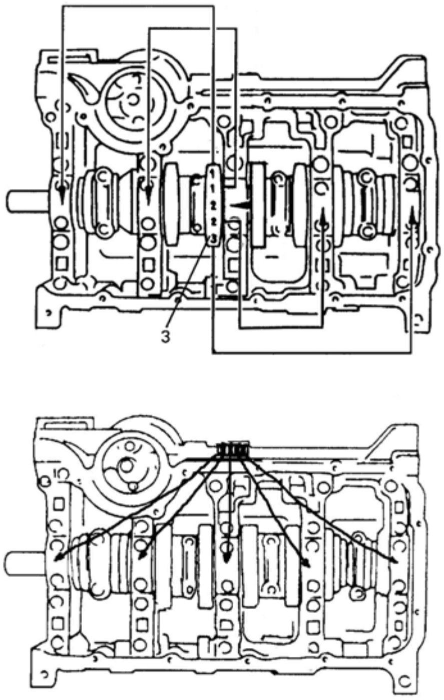


Fig 4-194

（5）As Fig 4-195 shown，check bearing shell clearance with plastic gauge。If clearance is out of limit, use thicker level bearing shell and check clearance again。

（6）When replacing crankshaft or cylinder block，select new bearing shell according to figure of mark on crank and figure mark corresponding of assorting surface on crankcase。

• **crankshaft rear oil seal assy**

As shown Fig 4-196，check the oil seal carefully for wear and damage。Replace it if necessary。

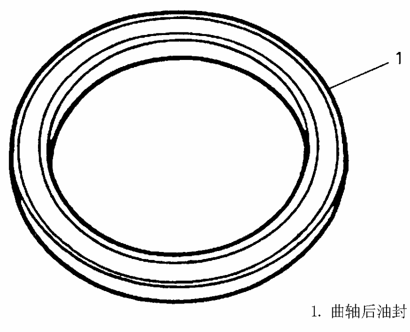


Fig4-196　1.crank rear oil seal

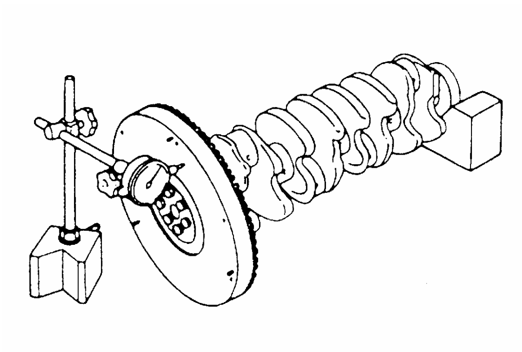


Fig.4-197

•Flywheel

1）If starting toothed ring is damaged、crack and wear，replace flywheel。

2）If clutch contact surface is damaged or wear badly，replace flywheel。

3）As shown Fig 4-197，check flywheel end runout with micrometre。

If the value is out of limit，replace wheel。

runout limit：0.2mm。

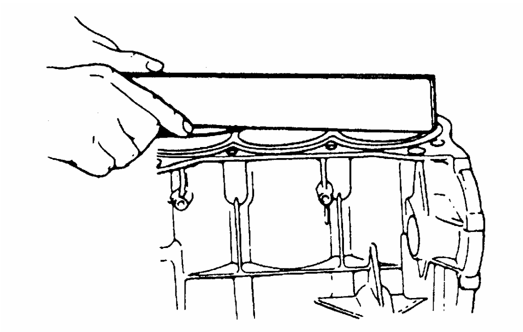


Fig 4-198

•Cylinder block

1）Plane degree inspection

As shown Fig 4-198，check the touching surface’s plane degree with ruler and gauge,if it is out of limit，repair it。

Plane degree limit：0.05mm

2）Cylinder grinding and reboring

（1）when any cylinder need reboring，all the other must rebore also。

(2) Select larger size piston according to cylinder abrasion degree。(See table 4-22)

Table 4-63

Size	Piston diameter
Increase 0.25	71.220~71.240mm
Increase 0.50	71.470~71.490mm

(3) As shown Fig 4-199, measure piston diameter with micrometer。

(4) Calculate bore diameter after reboring cylinder

D=A+B-C

D：bore diameter after reboring cylinder

A：measured piston diameter

B：Clearance between piston and cylinder=0.02-0.04mm

C：Grinding value=0.02mm

(5) Rebore and grind cylinder according to the calculated size.

CAUTION：

BEFORE REBORING，INSTALL CRANKCASE AND TIGHTEN THE BOLTS TO SPECIFIED TORQUE IN TURN，IN ORDER TO AVOID MAIN BEARING HOLE FROM DISTORTING。

(6) Measure the clearance of piston and cylinder after grinding。

4.3.7 Engine inspection and adjusting

● Cylinder pressure inspection

1) Warm-up the vehicle.

2) Stop the vehicle after warming-up the vehicle

CAUTION:
AFTER WARMING-UP THE VEHICLE , SET TRANSMISSION IN NEUTRAL GEAR, THEN PARKING THE VEHICLE

3) Remove every cylinder spark plug

4) In main fuse box, cut off power supply to ECU.

CAUTION:
IF DON' T CUT OFF POWER SUPPLY, SPARK MAY BE CREATED IN ENGINE BAY, AND PERHAPS LEAD TO BLAST

5) As shown Fig 4-200, install special tool in spark plug hole (cylinder pressure gauge). Special tool

(A): Cylinder pressure gauge

(B): Joint

(C): Hose

(D): Accessories

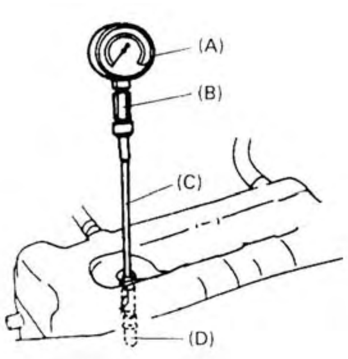


Fig 4-200

6) As shown fig 4-201, depress clutch pedal and accelerator control , make clutch be released and throttle be opened fully.

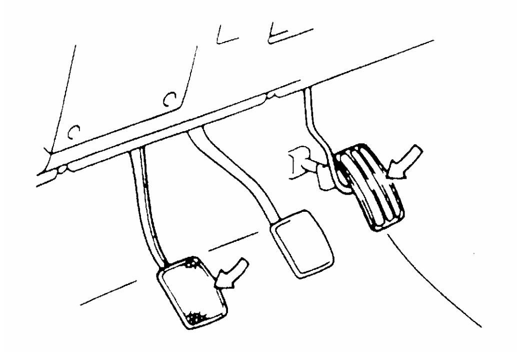


Fig4-201

7) Make the starter drive engine. Read the maximum pressure value. Pressure data is listed in table 4-64.

CAUTION:
WHEN READING PRESSURE VALUE , THE ENGINE' S SPEED IS AT LEAST 250RPM, BATTERY' S POWER CAPACITY MUST BE ENOUGH.

Table 4-64

	Cylinder pressure kPa (9.0kg/cm^2)
Standard value	1250 (12.5)
Limited value	900 (9.0)
Differential cylinder pressure	≤100 (1.0)

8) Repeat 6) --7) step , read the other cylinders' pressure separately.

9) After inspection, assemble spark plug, connect ignition coil.

●inlet manifold vacuum inspection

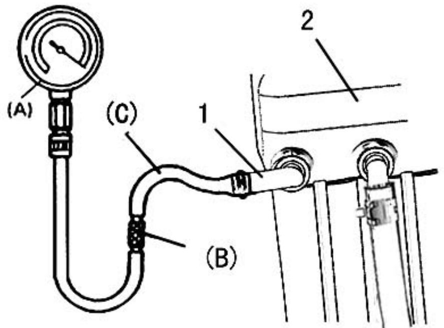
The vacuum of intake system indicates if the state of engine intake pipeline is in good condition. Inspection step is as follows:

1)Warm-up engine until the coolant temperature rises to normal temperature.

CAUTION:

SET IN NEUTRAL GEAR AFTER ENGINE WARM UP,PARKING THE VEHICLE

2)Stop engine,disconnect vacuum booster hose which connected with inlet manifold, then connect hose and special tool(vacuum gauge), as shown fig. 4-202



1、真空助力接管嘴

2、进气歧管稳压箱

1. Pressure regulate valve joint

2. Inlet manifold manostat

Fig.4-202

Special tool

(A): Vacuum gauge

(B): Vacuum gauge joint

(C): hose

3) Run the engine at idle speed, read vacuum gauge,

vacuum should be within the range as follow:

sea level idle vacuum::

56.0～70.6kPa(42～53cmHg)。

4)After inspecting,reconnect the vacuum hose.

●valve clearance inspection

1) Disconnect battery cathode

2) Remove valve chamber cover.

3) As shown fig.4-203, use 17mm double offset ring spanner to turn crank pulley clockwise till the bulge of camshaft is normal to the surface of adjusting gasket in the area of ① and ⑦(valve number is from ① to ⑧ as shown in fig.4-203)

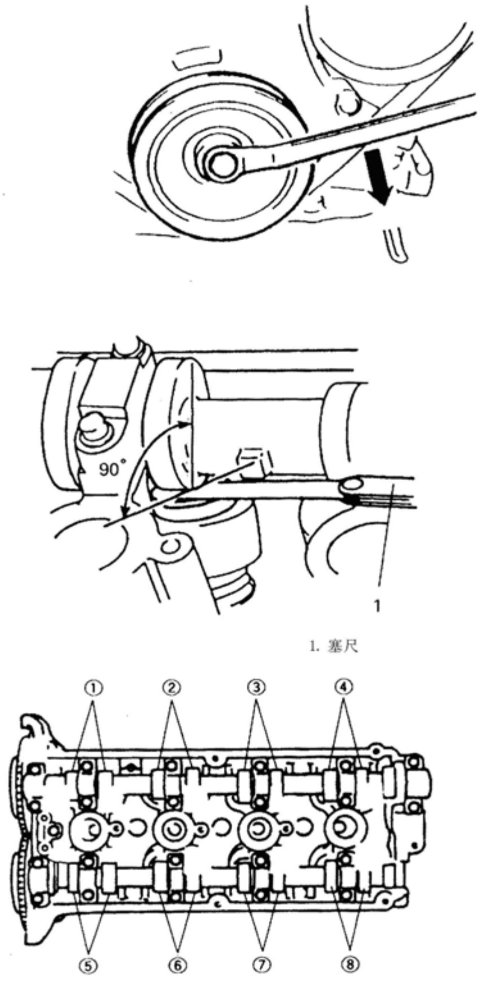


Fig.4-203

4) Use gauge to check valve clearance in sequence as follow

(1) check valve clearance in the area of ① and ⑦

(2) turning crankshaft for 90° clockwise with spanner of 17mm

（3）Insure bulge of camshaft is normal to in the area of the checked valve（in this condition it is ③ and ⑧)，If not，turn the crankshaft till it is normal to the surface of adjusting gasket.

（4）According to step of（2）and（3）,check valve clearance of ④ and ⑥

（5）According to step of（2）and（3）, check valve clearance of ② and ⑤。

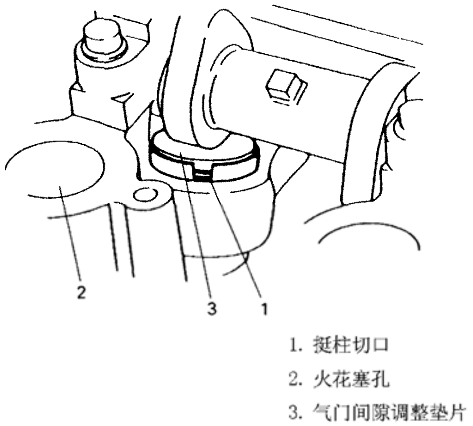
If the clearance is out of limit，replace valve clearance adjusting gasket till it reach limit。(The specified value see table 4-65。

Table 4-65

		Cool engine（15~25℃）	Hot engine（60~68℃）
Valve clearance（mm）	inlet	0.17~0.23	0.21~0.27
	oulet		0.20~0.26

● Replace valve clearance adjusting gasket

1）By turning the crankshaft to close the valve which need to be replaced，then turn the tappet to the location as shown in Fig.



1Tappet kerf　2. Spark plug hole
3. Valve clearance adjusting gasket

Fig.4-204

2）Turn the crankshaft to make the valve whose adjusting gasket need to be replaced locate in open state，then to remove the mounting camshaft bearing cover bolt whose adjusting gasket need to be replaced.

3）As shown fig.4-20，installing special tool. Special tool:

（A)：Tappet holder

CAUTION
DON’T PRESS SPECIAL TOOL ONTO ADJUSTING GASKET

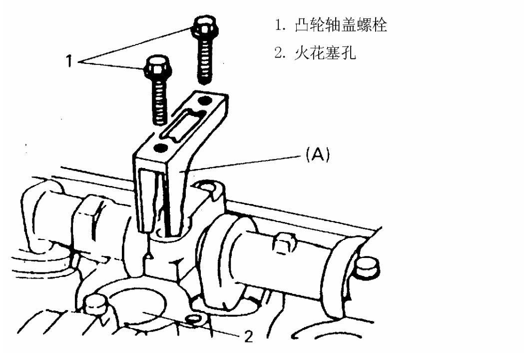
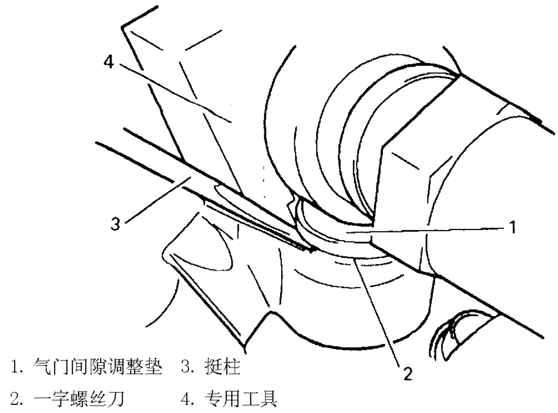


Fig.4-205

1Tappet kerf　2. Spark plug hole

4）As shown in fig.4-206，turn camshaft about 90°clockwise,take out adjusting gasket.



1. Valve clearance adjusting gasket 3. Tappet
2. Screwdriver with slotted head 4. Special tool

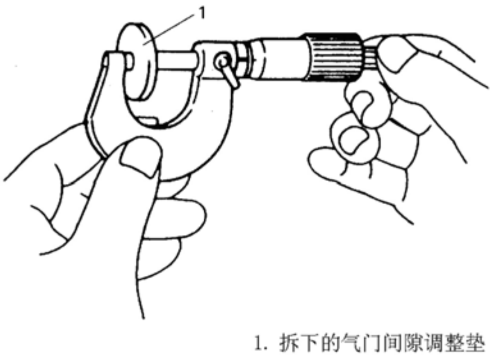
Fig.4-206

5) Measure thickness of replaced adjusting gasket, then to calculate the thickness of new one.

A=B+C-0.20mm

A: Thickness of new adjusting gasket (mm)

B: Thickness of replaced adjusting gasket (mm)



1. Valve clearance adjusting gasket diassembly

Fig. 4-208

6) Select adjusting gasket from table 4-66 ,install it to the tappet.

CAUTION
WHEN INSTALLING, THE SIDE WITH WORDS OF ADJUSTING GASKET FACES TO TAPPET

Adjusting gasket thickness table (mm) table 4-66

2.18	2.30	2.42	2.54	2.66	2.78	2.90
2.20	2.32	2.44	2.56	2.68	2.80	2.92
2.22	2.34	2.46	2.58	2.70	2.82	2.94
2.24	2.36	2.48	2.60	2.72	2.84	2.96
2.26	2.38	2.50	2.62	2.74	2.86	2.98
2.28	2.40	2.52	2.64	2.76	2.88	3.00

7) As shown fig. 4-209, turn camshaft counterclockwise, open valve and remove the special tool.

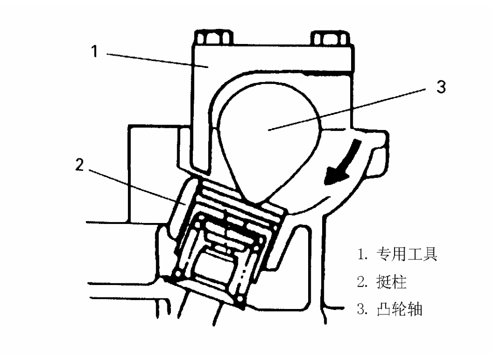
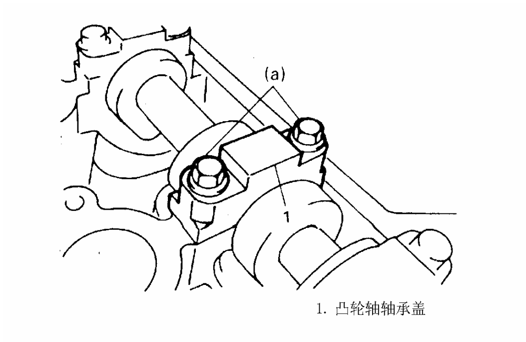


Fig. 4-209

1. special tool 2. tappet 3. camshaft

8) Tighten bolts to specified torque, check the adjusted valve clearance, as shown in Fig 4-210.



1. Camshaft bearing cover

Fig. 4-210

Tightening torque:

(a): 11 N•m

9) Install it in reverse sequence to disassembly after checking and adjusting all valve clearance.

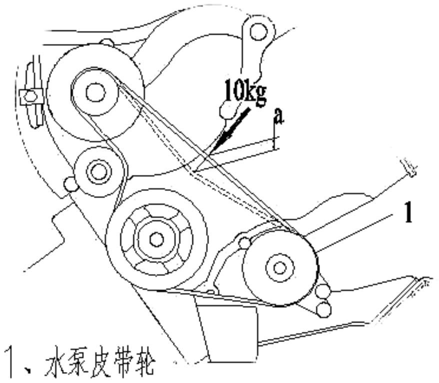
● Multi-wedge belt inspection

1) check belt for crack, distortion, abrasion and dirt lever, replace it if necessary.

2) As shown in Fig4-211, check tension of the belt. Adjust it if necessary.

Apply 10kg load on middle point of belt between water pump pulley and generator pulley , multi-wedge belt displacement is within 9～12mm.

CAUTION:
WHEN REPLACING NEW BELT,DISPLACEMENT OF ADJUSTING BELT IS 8～9MM。



1.Water pump pulley

Fig.4-211

Multi-wedge belt replacement

1）Disconnect battery power supply cathode;

2）detach A/C compressor belt;

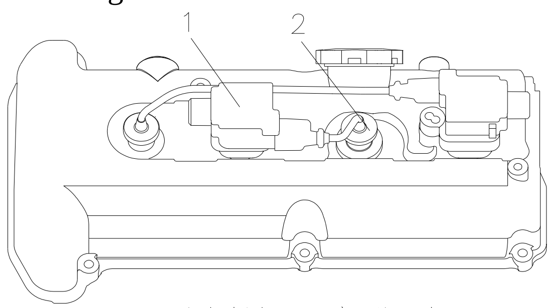
3）replace new multi-wedge belt;

4）connect battery cathode.

●Spark plug inspection and replacement

1）Clean dirt out of valve chamber cover, cylinder cover and surrounding of spark plug.

2）As shown fig. 4-212，loosen ignition coil screw, pull out the ignition coil and high pressure damp wire from the spark plug. Please pull the jacket cap nearby the spark plug, not to pull the high pressure damp wire directly avoid to damage it.



1.ignition coil　2.　high tension leads assembly

Fig.4-212

3）Remove the spark plug with the special spanner.

4）check the spark plug clearance, carbon deposit and insulator’s damage.

If abnormal please adjust the clearance and clean the carbon deposit or change a new spark plug.

Spark plug clearance　“a”：0.9±0.1 mm

5）Disconnect the fuel injector wire and the fuel injector.

6）Connect the spark plug to the high pressure damp wire.

7）Start the engine, inspect if the spark plug work or not. If it not work please inspect the high tension leads assembly, ignition coil part etc.

CAUTION
BE SURE THE FUEL PIPE IS NOT LEAKAGE AND NO FLAMMABLE GAS NEARBY WHE START THE ENGINE FOR 跳火 INSPECTION

8）Install the spark plug, tighten it according to the specified torque.

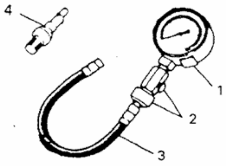
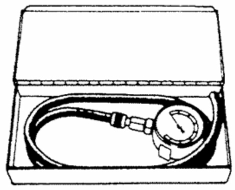
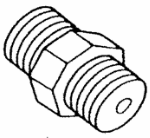
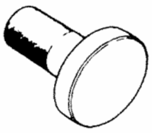
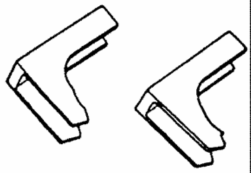
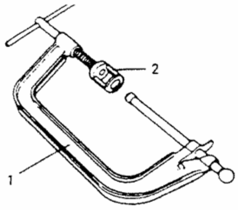
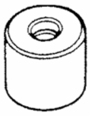
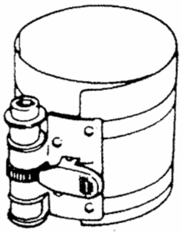
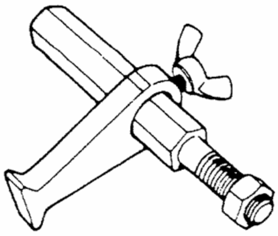
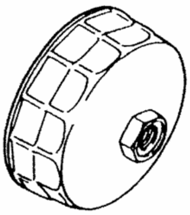
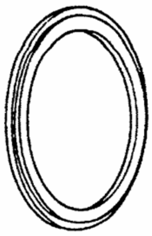
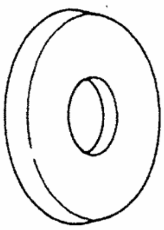
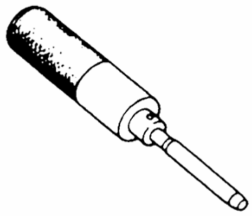
Tightening Torque：20±2 N•m

9）Install ignition coil and high tension leads assembly. Please press the damp wire jacket cap and don’t push the damp wire directly.

4.3.8 Special tools

Special tools as shown in Table 4-67。

Table 4-67

 一、1）. 缸压表 2）. 接头 3）. 管 4）. 附件	 二、真空表	 三、真空表接头	 四、机油压力表
 五、机油压力表附件	 六、轴承安装工具	 七、挺柱保持架	 八、1）气门提升装置 2）气门提升装置附件
 九、镊子	 十、气门油封安装工具附件	 十一、活塞环压缩工具	 十二、飞轮盘锁止工具
 十三、机油滤扳手	 十四、油封安装工具	 十五、油封导向工具	 十六、气门油封安装工具

1. 1) cylinder pressure gauge 2) joint 3) hose 4) attachment
2. Vacuum gauge 3. Vacuum gauge joint 4.oil pressure gauge
5. oil pressure gauge attachment 6. Bearing installer 7. Tappet holder
8. 1) valve lifter 2) valve lifter joint 9.Forceps 10.valve seal installer attachment
11.piston compressor tool 12.flywheel holder 13.oil filter wrench set
14.oil seal installer 15.oil seal guide 16. valve seal installer

4.3.9 Maintenance material

Maintenance material as shown in table 4-68。

Table 4-68

Sort	Commended Product	methed
Sealant	LETAI 5699	● Matching surface between cylinder block and oil pan ● Matching surface between cylinder and Synchronous chain cover shell
	LETAI 518	Matching surface between crankcase and cylinder block
	Oil proof silicon ketone sealant 耐油硅酮密封胶 HZ1213	● Six surface between cylinder head and seal gasket ● Matching surface between intake camshaft rear end cover and cylinder block
	50# seal glue 封口胶	Inlet manifold mat
Screw locking glue	LETAI 262	Oil press sensor
	LETAI 243	Flywheel fixed screw

5 LUBRICATION SYSTEMS

5.1 FUNCTION OF LUBRICATION SYSTEM

Supplying the oil to engine components continuously is basal task of lubrication system. The purpose of lubrication system is to reducing abrasion ,cool the parts, swashing , cleaning, absorbing vibration , anti- rusting and sealing。The components of engine will be shielded to reduce the damage and life of the part will be prolonged.

5.2 LUBRICATION MODE

Working condition of engine parts are in accordance with their loads and moving speed。So they need different lubrication intensity and different lubrication method.

1.Pressure Lubricating

Oil must be fed in certain pressure to the clearance of the friction surface which bear heavier loads and move faster, then the oil will form oil-velum and the parts get lubricated .In a certain pressure, flowing oil can get rid of friction oddments etc and cool the parts。

The areas need pressure lubrication are: crank main axle journal, axle shell and connecting rod axle shell，camshaft axle journal and cylinder cover supporter，rocker arm shaft and rocker arm etc。

2.Splash Lubricating

For the moving parts exposed, less load and lower speed, using oil drippings or oil fog splashed by moving parts to lubricate friction surface.

Parts that use splash oiling are: cylinder wall and piston ring, piston and piston pin, camshaft and rocker arm of valve mechanism。

3.Apply Lubricating Grease Periodically

For the moving parts of the Engine auxiliary system that bear less load and lower gliding speed，such as water pump bearing ,generator bearing, clutch bearing, tension adjusting pulley bearing. Because temperature of their friction surface is lower， applying lubricating grease termly can lubricate them。

5.3 CHOICE OF OIL

There are many kinds oil，selected oil should be accordance with working state of engine and season.

Glutinosity of oil is an important parameter，its unit is Lis， sorted according to movement glutinosity at 100℃。

Glutinosity of oil vary with air temperature. Glutinosity of oil reduce with temperature rising。So choose high glutinosity oil in summer and lower glutinosity in winter. The trademark of engine oil is as follows.

Southward all year, northward summer: 10W/30 SE, Northward winter : 5W/30 SE

5.4 LUBRICATION PRINCIPLES

1. Lubrication system structure

(1) Lubrication system structure

①source of circulating pressure——oil pump (contain pressure adjusting valve);

②oil line——main oil line 、lubrication oil line、throttle valve;

③storage set——oil basin;

④filtrate set——oil catcher 、oil filter;

⑤inspection set——oil dipstick、oil pressure sensor;

⑥drain oil jaws、drain oil plug。

2.Lubrication system working flow

活塞和缸体：Piston and cylinder block 连杆小端：Connecting rod small end

连杆大端：Connecting rod big end 曲轴轴颈：Crankshaft journal

缸体油孔：Cylinder body oil hole 机油滤：Oil filter 机油泵：Oil pump 油滤网：Oil filter net 安全阀：

Safe valve 旁通阀：By-pass valve 缸体壁：Cylinder wall
1.2.3 摇臂轴轴颈孔：1、2、3 rocker arm shaft journal hole
凸轮轴轴颈：Camshaft journal 第 5 摇臂轴轴颈孔：No.5 rocker arm shaft journal hole
缸盖调整螺钉支座孔：Cylinder cover adjusting screw seat hole
缸盖主油道：Cylinder cover main oil line 缸盖节流嘴：Cylinder cover throttle jaws
油底壳：Oil basin

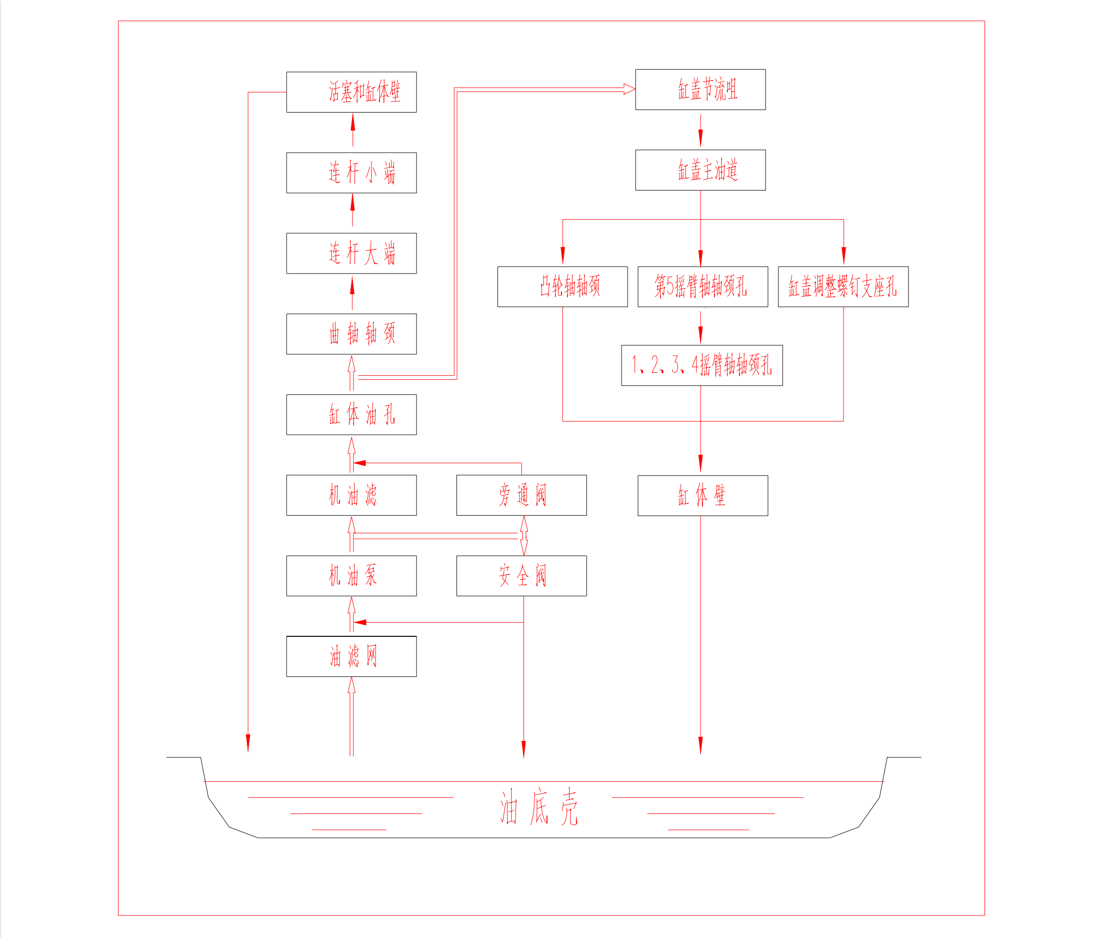


FIG.5-1 lubrication system main flow sketch map

1)Add oil from oil filler hole of the rocker chamber cover, oil is store in basin through oil line in the cylinder cover, cylinder block.

2)Inner meshing type oil pump installed on the crankshaft end run with crankshaft together, the bigger impurity in oil are filtered by oil catcher strainer, then oil enter pump through bend pipe of catcher。

3)After oil is supercharged by pump , oil enter filter through outlet of pump and cylinder block bottom。There is an oil pressure safety valve in oil pump, it begin working when oil pressure reach about $4.5kg/cm^2$, oil released reflow to oil basin。

4) Oil enter main oil line in the cylinder through center oil pipe on the oil filter installing seat after oil is filtrated by oil filter。

5) Main oil line of cylinder body is in the center of cylinder block and parallel to crank shaft , it is divided into 5 branch oil lines, impenetrate to 5 main bearing seats, lubricate crankshaft main bearing 。

6) Between crankshaft bearing 1、2、4、5 and connecting rod axle neck 1、2、3、4, should drill 4 inclined oil holes. In order to lubricate 4 connecting rod axle journal with oil induced from main axle journal。

7) Drill a horizontal oil line between crankshaft No.3 main bearing and main oil line inclined hole, make it to connect with vertical oil line , then enter throttle jaws on cylinder cover bottom。

8)Oil from throttle jaws enter main oil line of cylinder cover, oil in main oil line lubricate camshaft axle neck and bracket hole on the cylinder cover adjusting screw、No.5 rocker arm hole , then back into oil basin through cylinder body wall。

5.5 Main parts of lubrication system disassembly 、inspection and installation (except DA471QLR engine)

●Oil Pump (FIG.5-2)

• As shown in FIG.5-2, remove oil pump rear cover。

图 5-2

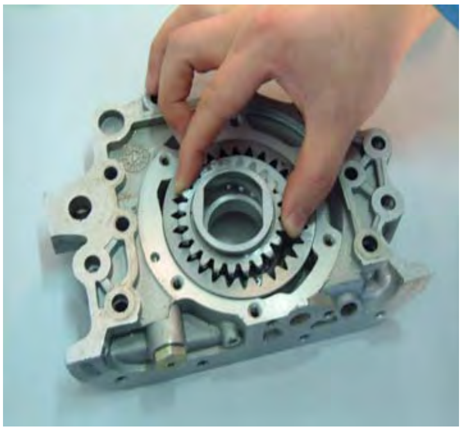


图 5-3

• take out inner gear (with outer tooth) . (FIG.5-3)

• take out outer gear (with inner tooth) . (FIG.5-4)

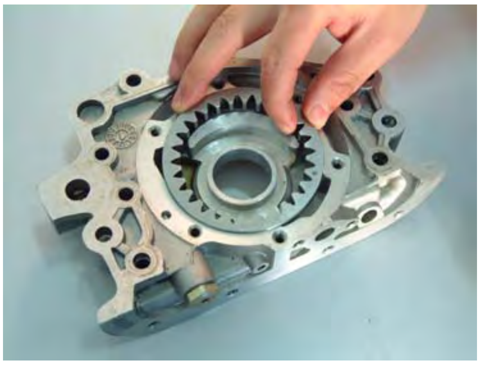


FIG.5-4

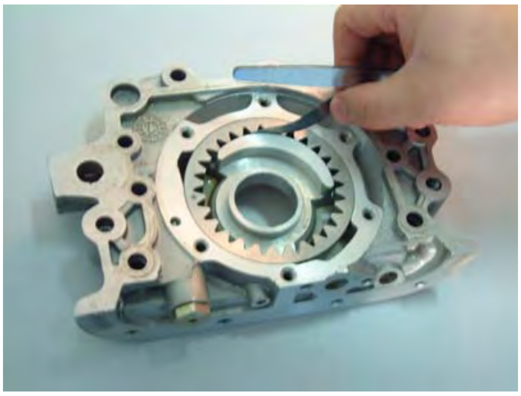


FIG.5-5

• Radial clearance between gear with inner tooth and stator.(FIG.5-5,TABLE 5-1):

TABLE 5-1

Standard	0.19~0.30mm

• Radial clearance between outer tooth gear and stator (FIG.5-6,TABLE 5-2):

TABLE 5-2

Standard	0.43~0.53mm

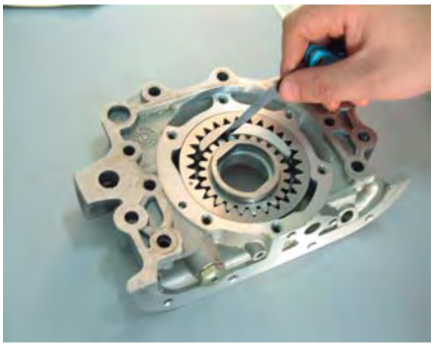


FIG.5-6

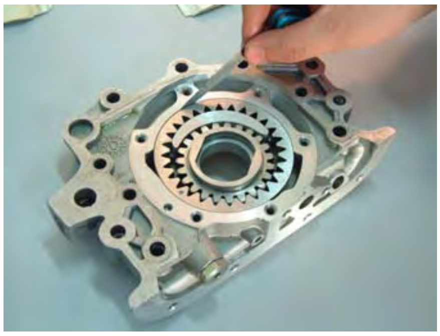


FIG.5-7

• radial clearance between outer surface of inner tooth gear and oil pump housing.(FIG.5-7,TABLE 5-3):

TABLE 5-3

Standard	Limit
0.12~0.20(mm)	0.3mm

• Side clearance

Insert plug gauge between edge gauge and gear end. The thickness of plug gauge is the side clearance(FIG.5-8)

TABLE 5-4

Standard	Limit
0.045~0.12mm	0.17mm

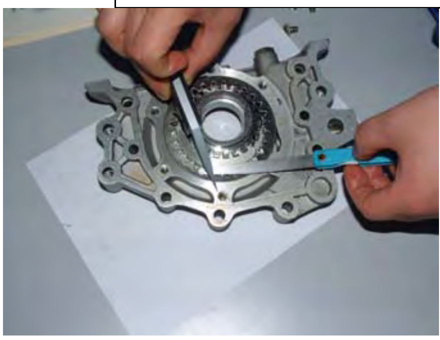


FIG.5-8

●Oil Pump Assembly

Clean and air parts disassembled, pay attention to the followings:

1) There is a pit mark in the inner tooth gear end. When installing, align pit mark with rear cover.

2) Apply 50# sealant on contact surface of housing and rear cover, when installing.

3) when installing oil pump to cylinder, be sure to use new gasket. After applying 50# sealant on two side of gasket, install oil pump to cylinder. The gasket facing to oil basin may protrude. Cut otiose portion off using a sharp knife. Ensure the edge smooth and even with end of housing.

CAUTION

Before installing oil pump, apply oil to lip of oil seal. When installing synchronization gear and synchronization belt, be sure to apply the specification.

Applying the specification strictly is very important , improper installation of synchronization gear and synchronization belt can not make the engine running well, and may make valve impact with piston top .(FIG.5-9)

FIG.5-9

5.6 ON CAR SERVICE (EXCEPT DA471QLR ENGINE)

1. Oil Filter Inspection

Replace oil filter according to section 2.3 periodically. Replace oil filter periodical and when it is dirty (FIG. 5-10)

FIG.5-10

FIG.5-11

2. Oil Pump Catcher Filtrate Net Inspection

Wash filtrate net of oil catcher periodically.

3. Oil Pressure Checking

The oil pressure signal lamp should go out at idling, also at high speed. If it does go out, check according to the followings:

• Check oil capacity in the oil basin . If oil level is lower, add oil to upper limit of dipstick。

The oil filter must be clean and the filtrate net should not be jammed.

• Confirm no leakage with any components of engine.

• remove oil pressure sensor from oil filter seat. Then, install pressure meter.

• start engine, run engine idling until raise the temperature of coolant to approximately 75~85℃.Raise the speed to 3000r/min. Read the pressure meter, the value should be 3.0~5.5kg/cm2。If not, check the oil pump.

CAUTION

When installation oil pressure sensor, spread white lead on screw and tighten to specified torque. Standard value:1.2~1.5kgf • m

4 Oil Inspection

Apply specified oil. When replacing oil, refer to TABLE 5—5.

TABLE 5-5

Item	Capacity of Oil (L)
Replacing oil periodic	2.8
Fill oil after heavy reparation	3.5

5 Oil Lever Inspection

To keep oil lever being between “LOW” and “HIGH” mark line, fill oil periodic is necessary.

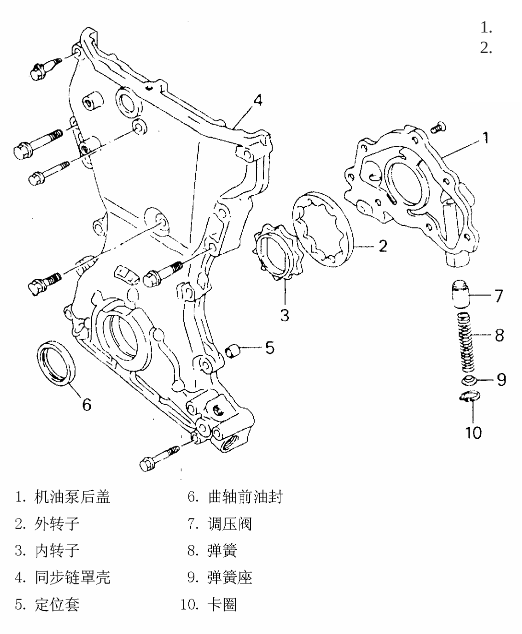
5.7 MAIN PARTS OF LUBRICATION SYSTEM DISASSEMBLY 、INSPECTION AND INSTALLATION (DA471QLR ENGINE)

● OIL PUMP

Removal

1）Disconnect battery cathode.

2）According to procedure of reading in front, disconnect synchronous belt shell as shown in fig.5-12.

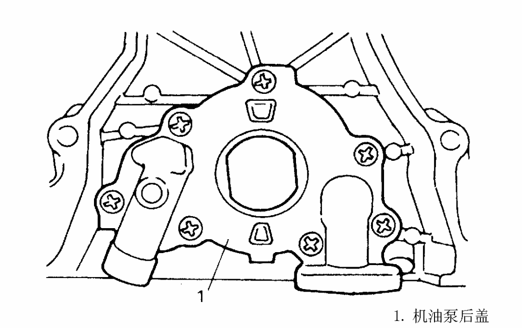


1. Oil pump rear cover 2.Outside rotor 3.Inside rotor 4.Synchronous belt shell 5.Go to set 6.Crank front seal 7.Pressure adjusting valve 8.Spring 9.Spring seat 10.Clip ring

FIG.5-12

Disassembly

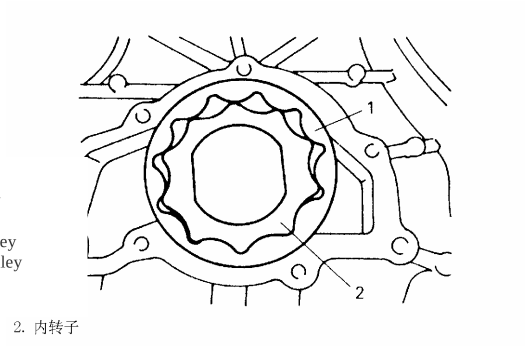
1） As shown in FIG.5-13，remove oil pump rear cover



1.Oil pump rear cover

FIG. 5-13

2）As shown in FIG.5-14，remove needle wheel and cycloid gear of oil pump.



1. 机油泵针轮
2. 机油泵摆线齿轮

1. Needle pulley
2. Cycloid pulley

2. 内转子

FIG.5-14

Assembly

1）Clean and air parts of disassemble.

2）Apply oil to the needle pulley of oil pump, cycloid pulley, cover shell seal lib,inside surface of synchronous belt cover and rear cover of oil pump。

3）As FIG.5-15，install needle pulley of oil pump and cycloid pulley to synchronous belt cover。

4）As FIG. 5A-4m, install oil pump rear cover, tighten 7 screws。Then check if gear work smoothly。

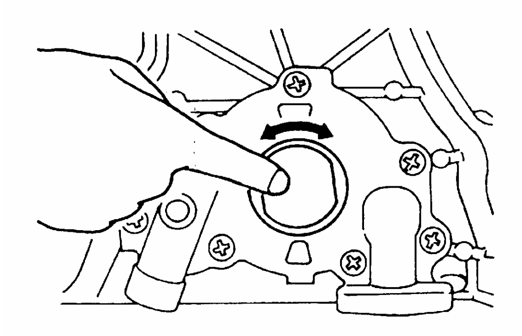


FIG.5-15

Installation

Refer to synchronous belt cover section.

Inspection

1)As shown in FIG.5-16，adjust lib of pump cover seal assy. Replace it if necessary。

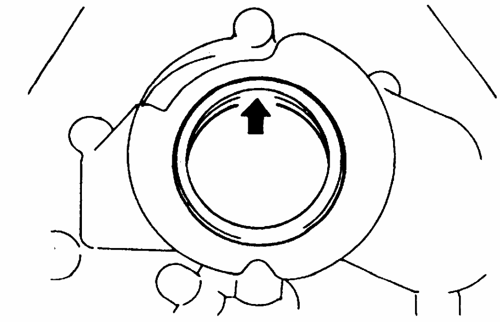
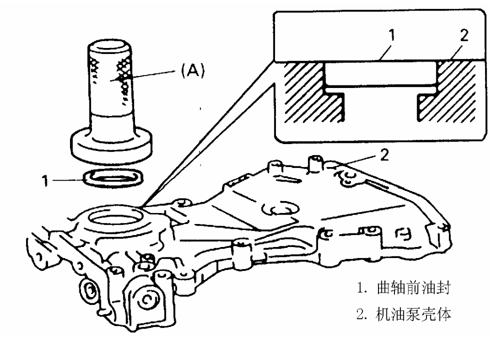


FIG.5-16

Caution
When installing seal of cover shell , align seal outside end With belt cover outside end。

Special tool:

(A): Bearing installer (FIG.5-17)



1.Crank front seal

2.Oil pump shell

FIG. 5-17

2) As shown in FIG.5-18, check needle wheel, cycloid gear, oil pump rear cover and synchronous belt cover for abrasion。

Measure

1) Radial Clearance

As shown in FIG.5-18, check the radial clearance between needle wheel and synchronous belt pulley cover。

If the clearance is out of limit, replace needle pulley of oil pump or synchronous belt cover。

Limit clearance of needle wheel and synchronous belt cover is 0.310mm。

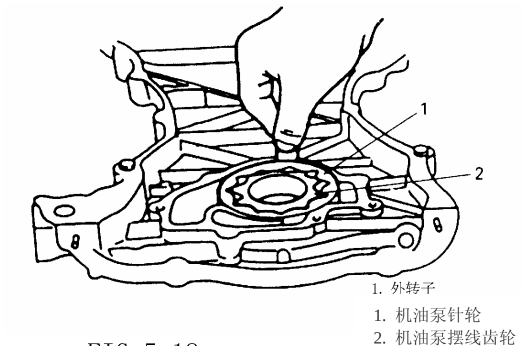


FIG.5-18

1.Needle wheel

2.Cycloid gear

2) Side clearance

As FIG.5-19, measure side clearance of oil pump with ruler and gauge。

Side clearance limit: 0.15mm

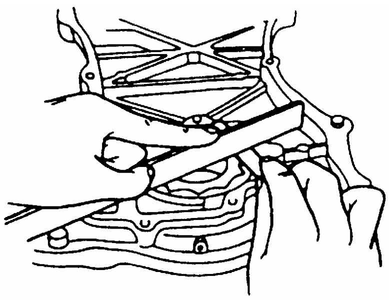


FIG. 5-19

5.8 ON CAR SERVICE（DA471QLR ENGINE）

●OIL CHECKING

1）Check capacity of oil by oil gauge。

2）Check the oil for cleanliness and glutinosity，if it is interfused with coolant or gasoline.

●CHANGE OIL

Check engine oil leakage before drain out oil。If leakage exit，insure damaged parts have been repaired before beginning next step。

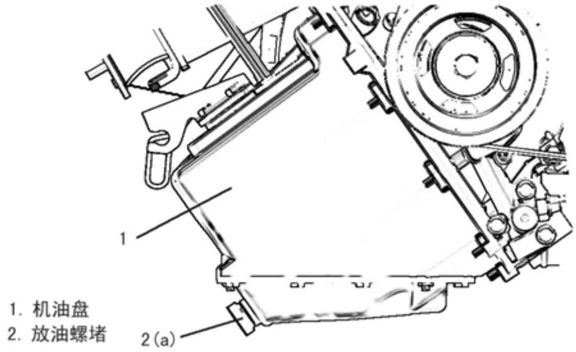
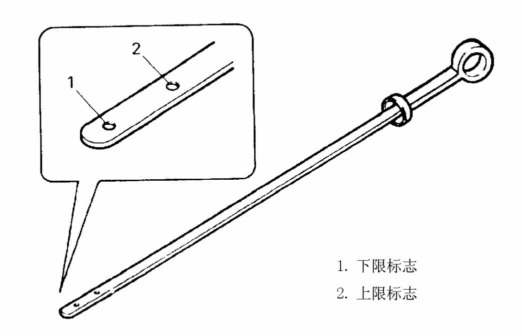


FIG.5-20 1. Oil basin 2. Drain oil plug



1.Sign of under limit 2. Sign of upper LIMIT

FIG.5-21

1）As FIG.5-20，loosen draining plug of oil basin to drain oil。

2）Then clean draining plug。re-install draining screw,tighten it to specified torque。

Tightening torque :（a): 25 N•m

3）Add oil to the upper limit of dipstick（about 3.7L)。Oil filler hole is in the valve chamber cover, dipstick shown in FIG.5-21。

4)Start engine and run it for 3 minutes。Check oil capacity after stop engine for 5 minutes。If necessary, add oil to upper limit。

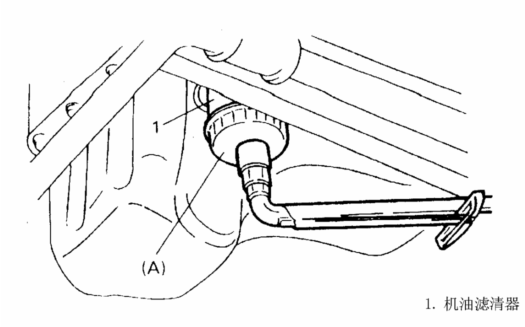
Oil Quantity

Oil Basin	About 3.7L
Oil Filter	About 0.2L
Others	About 0.1L
Totalize	About 4.0L

5) Check oil filter and drain oil screw for leakage。

● REPLACING OIL FILTER

1) As FIG.5-22，detach oil filter with oil filter spanner (Special tool)。



1.Oil filter

FIG.5-22

Special tool

(A): Oil filter spanner

2) Apply oil to the new “○” type ring of oil filter。

2) As FIG.5-23，tighten the new oil filter till “○” type ring contact the mounting surface by hands。

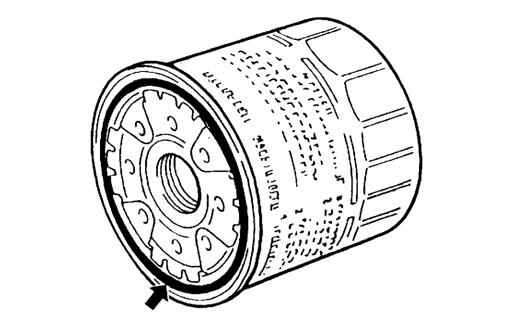


FIG.5-23

CAUTION
Tighten oil filter properly, till “○” type ring contact mounting surface for the first time。

4) As FIG.5-24，tighten oil filter to 3/4 circle from mounting surface contact point with oil filter spanner。

(A): Oil filter spanner

Tightening torque: (a): 14 N•m

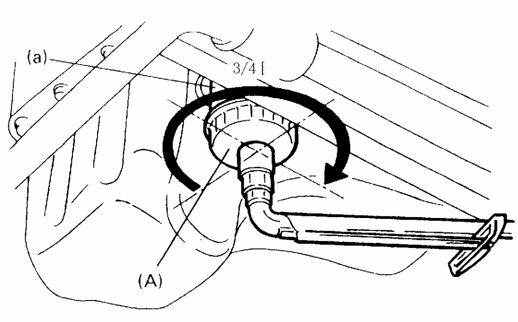
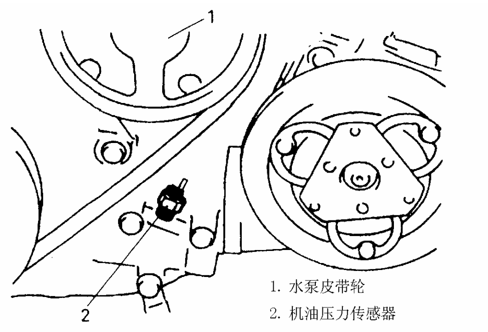


FIG.5-24

●Oil Pressure Checking

CAUTION
Check as follows each item before check oil pressure：
● Oil capacity in the oil basin。If oil level is lower，add oil to upper limit of dipstick。
● Oil quality：if oil has lost original colour，replace oil。
● Oil leakage ：if finding oil leakage，repair it。

1）As FIG.5-25，remove front bumper and oil pressure sensor on the synchronous belt cover



1. Water pump pulley
2. Oil pressure sensor

FIG.5-25

2)Install special tool (oil pressure gauge) on the oil pressure sensor original position，as FIG.5-26。

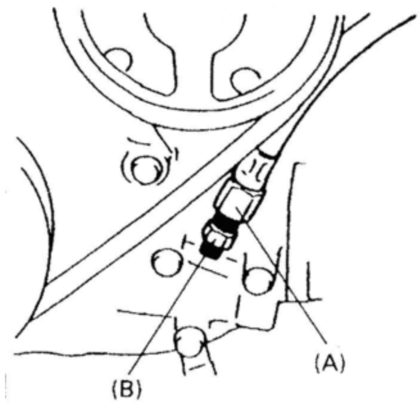


FIG.5-26

Special tool

（a)：Oil pressure gauge

（b)：Oil pressure gauge accessory

3）Start engine, warm up to normal working temperature。

CAUTION
After engine warming up, put transmission on neutral position with the vehicle braked。

4）After engine warm up，measure oil pressure when engine rotation speed is 4000rpm。

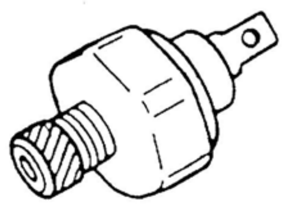
4000rpm oil pressure range：330～430kpa

5）Stop engine and detach oil pressure gauge。

6）apply glue letai262 to thread before installing oil pressure sensor。

Tightening torque（FIG.5-27）

（a）：12N•m



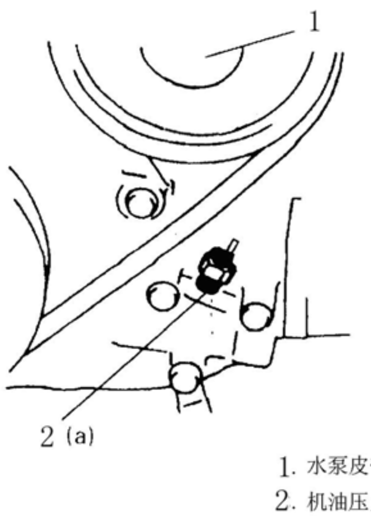


FIG.5-27 1-Water pulley

2-Oil pressure sensor

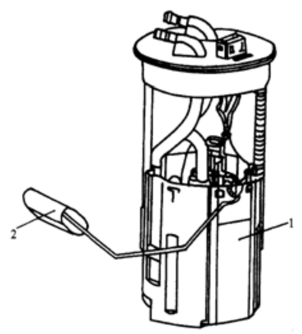
7）Start engine，check oil pressure sensor for leakage. repair it If leakage .

6 FUEL SYSTEMS

6.1 FUEL BUMP

●GENERAL DESCRIPTION

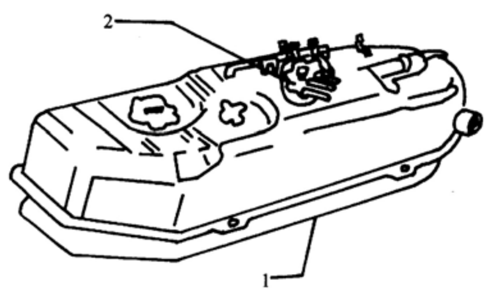
DELPHIN fourth generation turbo type single level fuel pump is adopted. (FIG.6-1) The turbo is driven by 12V direct current dynamo. It sucks the fuel and press it to export. There is single-direction valve in the export of fuel bump. When the engine stopped, the single-direction valve can keep the pressure in fuel system in normal area, and avoid leakage or refluence. It can also ensure easy start again of engine. There is fuel level sensor in the pump; it can measure the level of the fuel in the fuel tank.



1. Fuel pump 2. Fuel level gauge float

FIG. 6-1

The pump is installed in the fuel tank. (FIG.6-2) This mode makes the fuel feed system simple; it is difficult to occur the gas resistance and the fuel leakage. The pump is installed adopting flexible installation mode, it can reduce the vibration to transfer to the pump.



1.Fuel tank 2. Fuel pump

FIG.6-2

The fuel pump can work only when there is enough fuel in the fuel tank. If there isn't fuel in the fuel tank, pump will burn due to bad cooling. So, when the engine running or the car is driven, there must be enough fuel in the fuel tank. The filled fuel is not less than 8L when the car is filled first or the fuel in the fuel tank is fully consumed in order to keep the level of the fuel in the fuel tank over the level of the inlet of the reserve cup. Then the inlet of the pump in the reserve cup is immerged by the fuel, the car can start successfully.

• Removal

CAUTION
Prohibit smoking and placing “NO SMOKING” signs on working place. Be sure to have CO2 fire extinguisher in handy place. Wear safety goggles.

（1） Disconnect “-” terminal from battery;

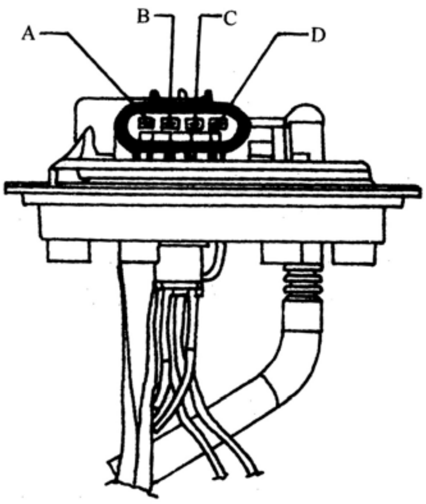
（2） Remove the fuel tank cap to de-pressurize the fuel tank, and then install the cap.

（3） Hang up the car.

（4） Disconnect the connector between the body wiring harness and the fuel wiring harness.

（5） Remove the bleeder to drain the fuel.

（6） Rem incept the rudimental fuel to use vessel.



on
Reche ess are removed before removing the fuel tank.

（7） Rem

(8) Rem r hose on the fuel pump;

(9) Rem hen take out the fuel pump from the fuel tank.

●Inspect

(1) Cl

After gasoline (must be in fire control environment), get it to the V. Mark “A” is to pump positive pole, mark “D” is to pump e fuel comes from feed pipe. If the pump is ok, the fuel come FIG.6-3)

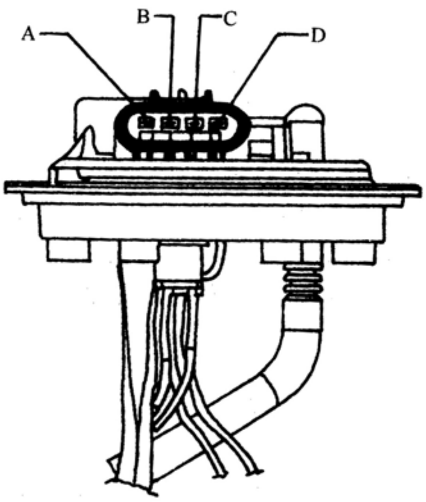
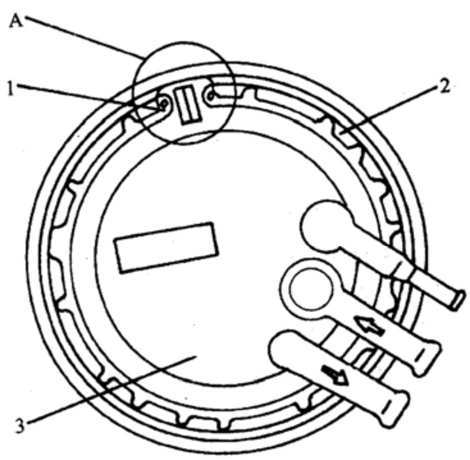


Fig.6-3

（2）Check the fuel level sensor

After taking out the fuel pump, open multimeter and turn to ohm shift, connect positive and negative poles to the opposite pins, which marked with “B”, “C” （FIG.6-3）on the flange. Move the float arm slowly and in an even speed along float movement direction. In normal way, the output resistance shows on multimeter is continuous and various. Otherwise it is failure.

• Installation (FIG.6-4)



1.Clip 2.Fuel tank flange 3.Pump cap

FIG.6-4

It is the reverse of removal procedures. First, apply grease to fuel pump sealing ring contacting with fuel tank, then install fuel bump into fuel tank. Pay attention to "A" shown in FIG.6-4, align the project on fuel bump cap with groove in fuel bump flange. Press cap around equably to install fuel pump into fuel tank. Install clip into flange groove from one end in turn, then bend the other end to press clip into groove. Now , the fuel pump installation is completed。

6.2 OUTLINE

● On car service

When checking fuel system, pay attention to the followings:

(1) Disconnect "-" terminal from battery.

(2) Do not smoke.

(3) Place "NO SMOKING "sign.

(4) CO2 fire extinguisher must be prepared.

(5) Work in the place of no fire source (gas heater, etc.) and good ventilation.

(6) Wear safety glasses;

(7) Remove the fuel tank cap to de-pressurize the fuel tank, and then install the cap.

(8) Care fully reduce the fuel pressure not to make fuel sprayed out due to the still high pressured fuel line after stopping engine when removing or disconnecting the system.

(9) Connecting of full hoses is different by the kind of pipes. Connect the right hoses as shown in the figure 6-5.

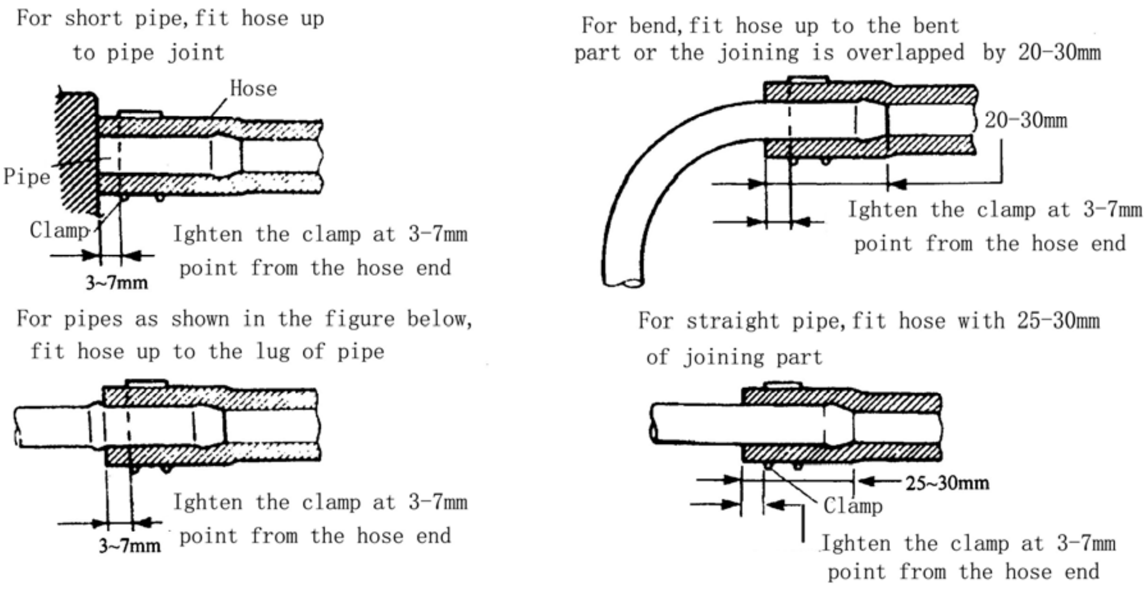


FIG. 6-5

6.3 FUEL FILTER

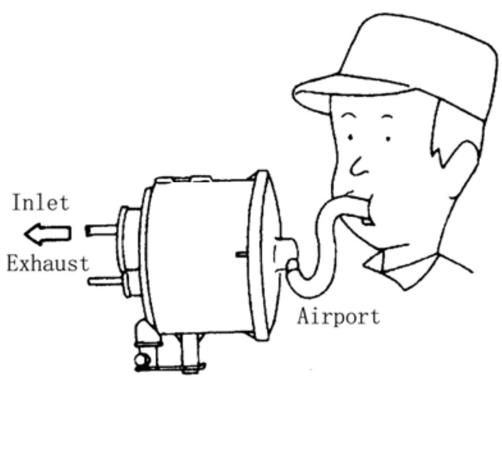
The fuel enters the fuel filter from inlet, pass through the filter element, and then enter the main pipe through the outlet. The shape of filter is cylinder. It isn’t disassembled. Replace it referring to section 2.3 .

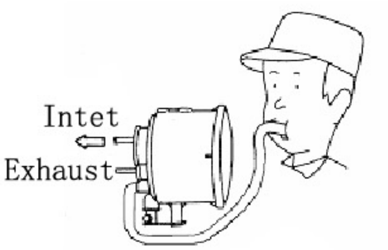
6.4 EMISSION CONTROL SYSTEM

The fuel vapour produced in the fuel tank can be gathered by the charcoal in the canister. When the engine run，fuel vapour enter into chamber to burn through intake manifold.

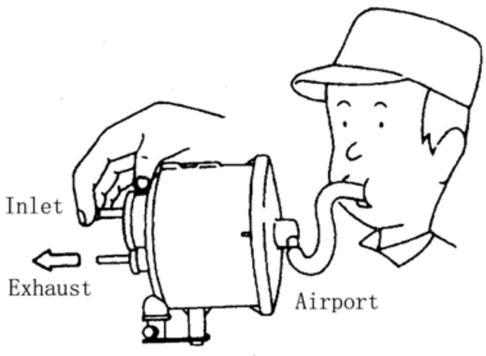
When the engine stops, the fuel vapour produced in the fuel tank can be gathered by the charcoal in the canister, it is reserved in the canister. When the engine run，the fuel vapour produced in the fuel tank enter into intake manifold for the negative pressure .

（1） Check 1(FIG. 6-6a) 、6-6b))





6-6a) For Europe II fuel vapour state

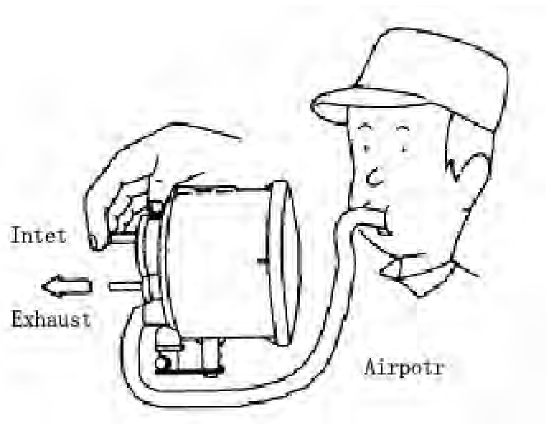


6-6b) For Europe III fuel vapour state

Blow out strongly at the airport under canister to inlet, and check the airflow.

（2） CHECK 2(FIG.6-7a)、6-7b)))

Clog the inlet of canister with hand and blow out at the airport below, and check airflow to exhaust port



6-7a) For Europe II fuel vapour state

6-7b) For Europe II fuel vapour state

7 ENGINE COOLING

7.1 GENERAL DISCRITION

The cooling system consists of the radiator cap, radiator, water reservoir tank, hoses water pump, cooling fan, thermostat.

1. Radiator Cap (fig.7-1)

A pressure-vent cap is used on the radiator. The cap contains a pressure valve and vacuum valve. The pressure valve is held against its seat by a spring of pre-determined strength which protects the cooling system by relieving the pressure if the pressure in cooling system rises by 1Kgf/cm2. The vacuum valve is held against its seat by a light spring which permits opening of the valve to relieve vacuum created in the system when it cools off and which otherwise might cause the radiator to collapse.

The cap has its face maked1.1, which means that its pressure valve opens at 1.1kgf/cm2.

CAUTION

Do not remove radiator cap to check engine coolant level.

Check coolant visually at the see-through water reservoir tank.

Coolant should be added only to the reservoir tank as necessary.

CAUTION

As long as there is pressure in the cooling system，the temperature can be considerably higher than the boiling temperature of the solution in the radiator without causing the solution to boil. Remove of the radiator cap while engine is hot and pressure is high will cause the solution to boil instantaneously and possibly with explosive force, spewing the

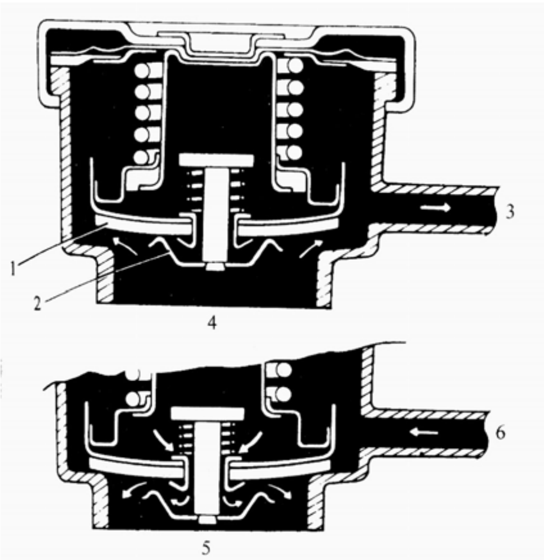


Fig 7-1

1 Pressure valve 2 Vacuum valve 3 To water reservoir tank

4 Pressure relief 5 Vacuum relief 6 From water reservoir tank

2 Water Reservoir Tank

A “see-through” plastic reservoir tank is connected to the radiator by a hose. As the car is driven, the coolant is heated and expands. The portion of the coolant displaced by this expansion flows from the radiator into the reservoir tank. When the car is stopped and the coolant cools and contracts, the displaced coolant is drawn back into the radiator by vacuum. Thus, the radiator is kept filled with coolant to the desired level at all times, resulting in increased cooling efficiency.

Coolant level should be between “FULL” and“LOW” marks on the reservoir tank.

Coolant should be added only to the reservoir tank as necessary

3 Water Pump

The centrifugal type water pump is used in the cooling system. The pump impeller is supported by a totally sealed bearing. The water pump can not be disassembled. (FIG.7-2)

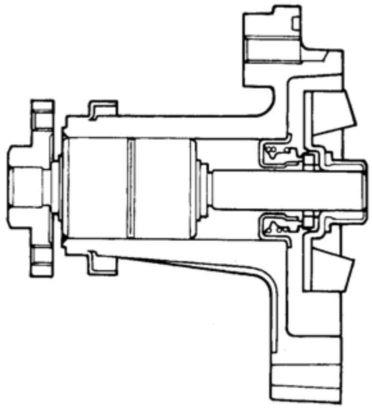


FIG.7-2

4 thermostat(FIG.7-3, TABLE 7-1)

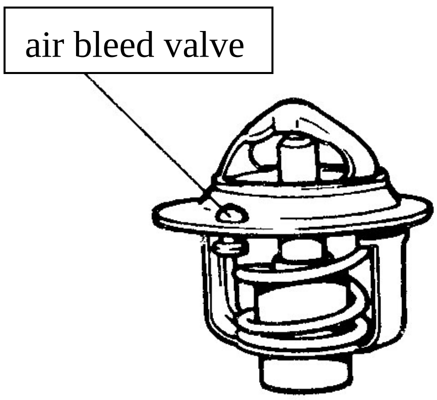


FIG.7-3

A wax pellet type thermostat is used in the coolant outlet passage to control the flow of engine coolant, to provide fast engine warm up and to regulate coolant temperatures.

When the pellet is heated and expands, the metal case pushes down the valve to open it.

Thus, the valve remains closed while the coolant is cold, preventing circulation of coolant through the radiator.

At this point, coolant is allowed to circulate only throughout the engine to warm it quickly an evenly.

As the engine warms, the pellet expands and the thermostat valve opens, permitting coolant to flow through the radiator.

In the top portion of the thermostat, an air bleed valve is provided; this valve is for venting out the gas or air, if any, that is accumulated in the circuit.

TABLE 7-1

Thermostat functional spec. (±1.5°C)	
Temo. at which valve begins to open	82°C
Temo. at which valve become fully open	95°C
Thermostat valve lift	over 8mm, 95°C

5 Electric Fan

The heat of cooling system is brought away by cool wind through electric fan. The electric fan has two kind of speed. The speed is controlled by engine ECU according to water temperature.

High speed：ON：98.5℃

OFF：93℃

Low speed ：ON：92.5℃

OFF：87℃

7.2 Removal

> CAUTION
>
> Before removing any parts of cooling system, be sure to check coolant for cool.
>
> Before removing any parts of cooling system, be sure to check if negative cable is disconnected at battery.

1 Coolant Drain

1)Remove Radiator Cap.

2)Run the engine until the thermostat is open and the coolant is flowing through the system.

3)Stop engine and open radiator drain plug to drain coolant.

4)Remove the heater air bleed hose, and loosen thermostat air bleed valve(FIG.7-4, FIG.7-5)

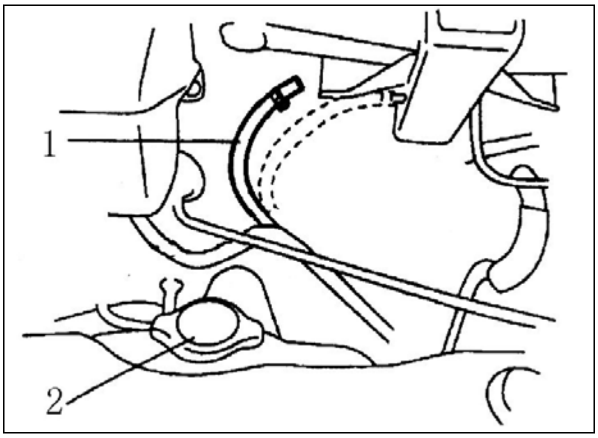


FIG.7-4

1、Heater air bleed hose　2、Radiator cap

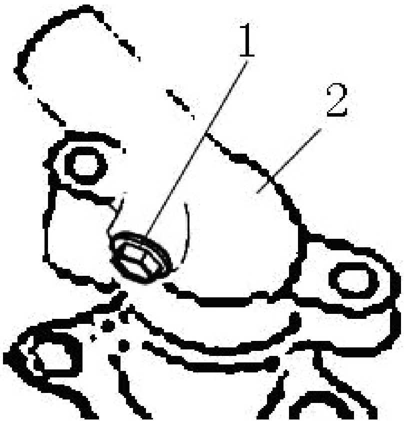


FIG.7-5

1、Air bleed valve　　　　2、Thermostat cap

5)Remove reservoir tank, and drain coolant.

2　Engine Cooling Hoses

（1）Drain cooling system.

（2）Loosen clamp of cooling hoses.

3　Water Pump Belt

（1）Loosen water pump belt tensioner

（2）Take down belt.

4　Electric Fan Removal

(1) Disconnect the wiring

(2) Remove electric fan.

5　Radiator Removal

（1）Drain cooling system.

（2）Remove inlet guide pipe and connecting wiring.

（3） Remove radiator inlet and outlet hoses from radiator.

（4） Remove radiator bracket and electric fan.

（5） Remove radiator。

6 Thermostat Removal

（1） Drain cooling system.

（2） Remove gearlever and cable from transmission and control shaft referring to correlative section.

（3） Remove central box.

（4） Remove thermostat cap from intake manifold.

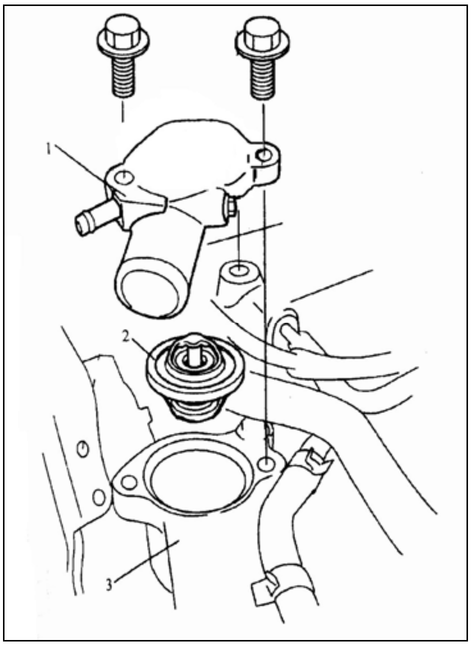


FIG.7-6

1、Thermostat cap 2、Thermostat 3、Intake manifold

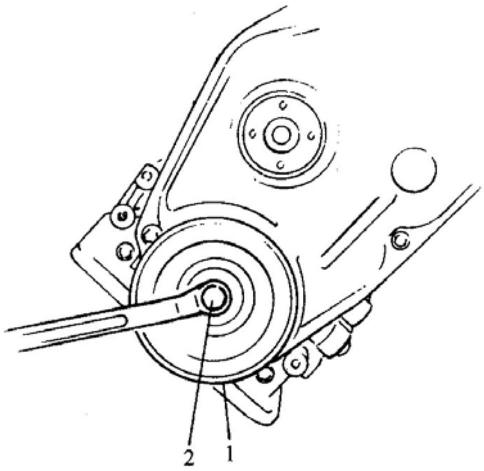
（5） Remove thermostat.

7 Water Pump Removal

（1） Drain cooling system. (Refer to coolant draining)

(2) Loosen water pump belt tensioner and remove water pump pulley and belt.

(3) Remove crank shaft pulley (FIG.7-7)



1 Crank shaft pulley   2 Crank shaft pulley bolt

FIG.7-7

(4) Remove timing belt outside cover (FIG.7-8)

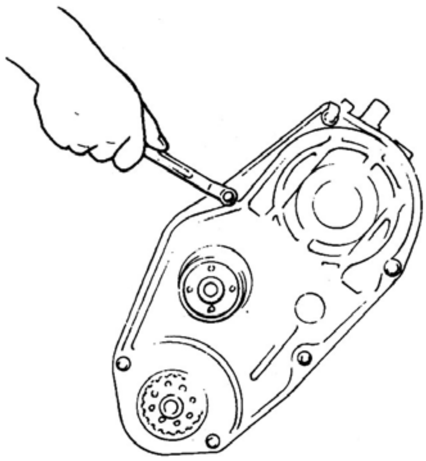


FIG.7-8

(5) Loosen tensioner screw (FIG.7-9)

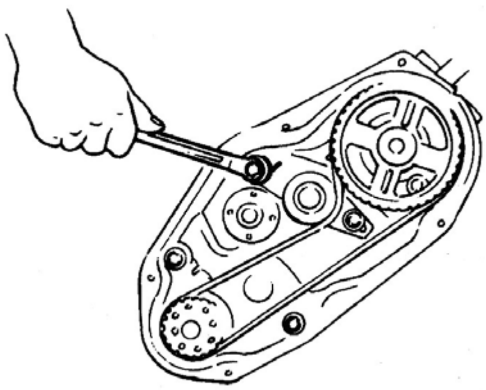


FIG.7-9

(6) Remove belt tensioner.

(7) Remove camshaft timing belt pulley using special tool “A”(FIG.7-10)

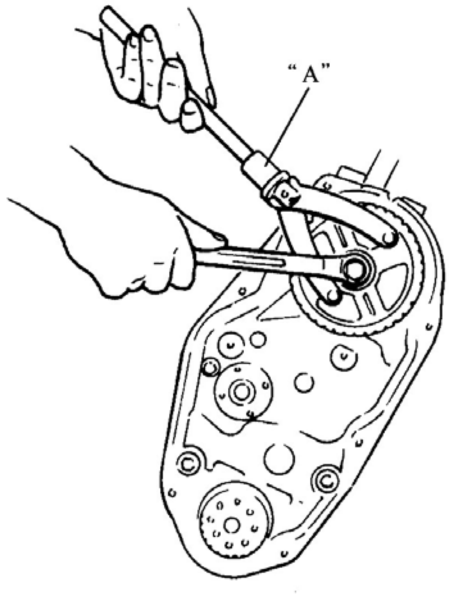


FIG.7-10

(8) Remove crankshaft timing pulley.

(9) Remove timing belt inner cover.

(10) Remove water pump(FIG.7-11)

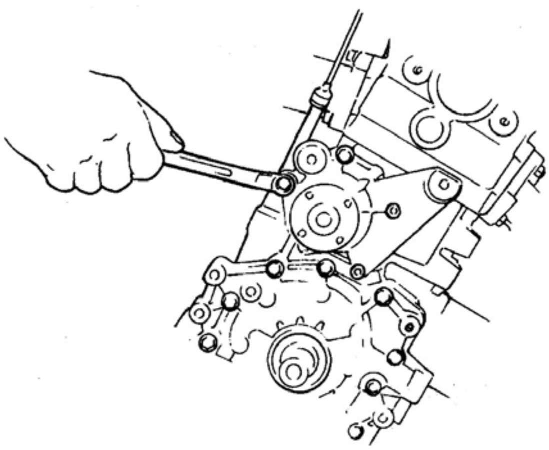


FIG.7-11

7.3 COMPONENTS INSPECTION

1 Thermostat

1) Make sure that the air bleed valve of the thermostat is clear. Should this valve be clogged, the engine would tend to overheat (FIG.7-12)

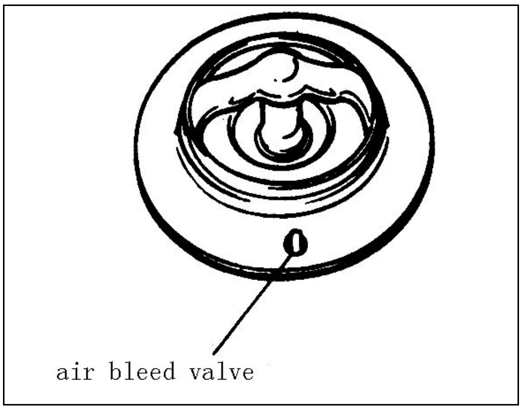


FIG.7-12

2) Check the valve seat for some foreign matters being stuck which prevents the valve from seating tight.
3) Check the thermostatic movement of the wax pellet as follows:(FIG.7-13)。

- Immerse the thermostat in water, and heat water gradually.
- Check that valve starts to open at specification temp.
- If the valve starts to open at a temperature substantially below or above, the thermostat unit should be replaced by a new one. Such a unit, if re-sued, will bring about overcooling or overheating tendency.

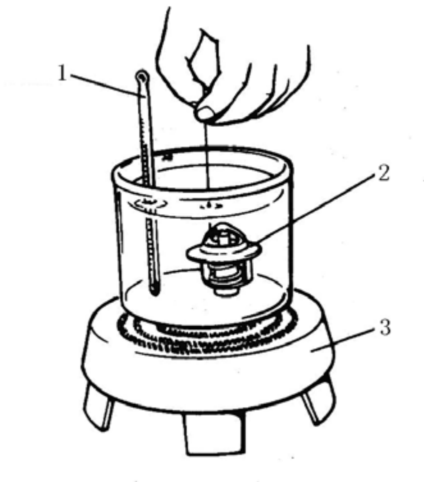


FIG.7-13

1-Thermometer；2-Thermostat；3-Heater

2.Radiator

If there being serious rust or furring in inside of radiator, clean it with radiator scour. The furring and rust will produce sometime later through using the commended coolant. So clean the radiator periodic.

Check radiator core for bent or staving, straighten the bent fin. Clean the core for furring and dirty if necessary.

Serious rust or furring inside radiator will affect cooling effect. Distortional or bent radiator vane will baffle air to affect effect ion.

The interval time of radiator cleaning is about two years（Recommended）

3 Water Temperature Sensor.

Refer to “multi-instrument” in section 18.

4 Water pump

> CAUTION
>
> Do not disassemble the water pump.
>
> If any repair is required on the pump, replace it as assembly.

Rotate the water pump by hand to check for smooth operation. If the pump does not rotate smoothly or makes an abnormal noise, replace it. (FIG.7-14)

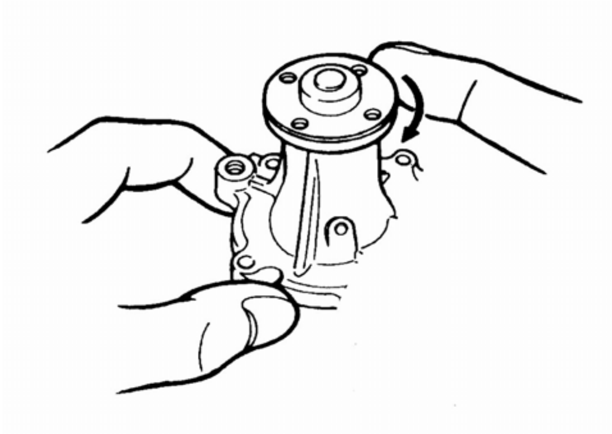


FIG.7-14

5 Electric Fan

TROUBLESHOOTING (TABLE 7-2): TABLE 7-2

Phenomena of Trouble	Potential Cause	Correction
Out of action	1. Open, short or bad contact of correlation circuitry or connector	Check, repair or connect
	2.Bad contact of fan conversion	Replace
	3. Malfunction of low speed fan relay	Replace
	4.disconnect of fan generator	Check, repair or replace
Out of action in low speed	1. Bad contact of fan conversion	Check, repair or connect
	2. Open, short or bad contact of correlation circuitry or connector	Check, repair or connect
Out of action in high speed	1． Malfunction of high speed fan relay	Replace
	2． Malfunction of Coolant temperature controller	Replace
	3． Malfunction of coolant temperature meter	Replace
	4． Open, short or bad contact of correlation circuitry or connector	Check, repair or connect

7.4 INSTALLATION

1 Water Pump

1） Install new water pump gasket on cylinder.

2） Install water pump on cylinder.

Tightening Part	Tightening Torque	
Water pump mount bolt and nut	9~12 N. m	0.9~1.2 Kgf.m

3) Install timing belt inside cover.

4) Install crank shaft timing belt guide plate and timing pulley.

5) install camshaft timing pulley.

Tightening Part	Tightening Torque	
Camshaft Timing Pulley Bolt	50~60 N. m	5.0~6.0 Kgf.m

6) Remove cylinder head cover and loosen valve adjusting screw of intake and exhaust rock arm

7) Install belt tensioner, tension spring, timing belt and outside cover.

CAUTION

Be care when installing belt tensioner and timing belt. Refer to correlative section.
Tighten bolts and nuts to specified torque.

8） Install crank shaft pulley, water pump pulley, water pump belt.

9） Adjust the clearance between intake valve and exhaust valve.（Refer to engine section）

10） Adjust water pump belt tension.

The belt drive generator and water pump. Check belt tension,. The belt is proper tension when a thumb pressure (10kg) applied to the middle point between water pump pulley and crankshaft pulley deflects it 10~15mm. Check belt for aging, replace if necessary.

Note：when replacing new belt，the belt deflection is 7~10mm。

CARTION

The right method of adjusting belt tension is that loosens three generator mounting bolts and displace the generator to slacken or tighten the belt.

Loose or wearing belt often can result in engine overheating. To keeping the belt aspect well, replace it periodical.

2 Thermostats

1） Install thermostat to intake manifold (FIG.7-15)

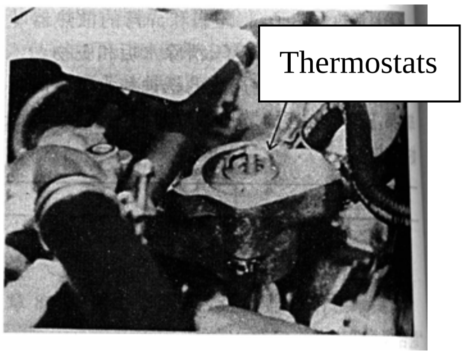


FIG.7-15

2） Install gasket and thermostat cap to intake manifold.

3） Refill cooling system.

3 Water pump belt

When the water pump belt is removed, reinstall tighten bolt and nut and readjust the belt tension to the specification.

4 Radiators

It is the reverse of removal procedures，pat attention to the followings：

1） Install tighten bolt and nut rightly;

2） Install fan ；

3） Tighten radiator bracket bolt;

4） Fix inlet and outlet hoses with clip.

5） Fill cooling system with a proper coolant.

7.5 SERVICE

1 Water Pump Belt

1） Check belt for crack, deformation, wear and cleanness，the belt is in proper tension when a thumb pressure(10kg) applied to the middle point between water pump pulley and crankshaft pulley deflects it 10~15mm. (FIG.7-16)

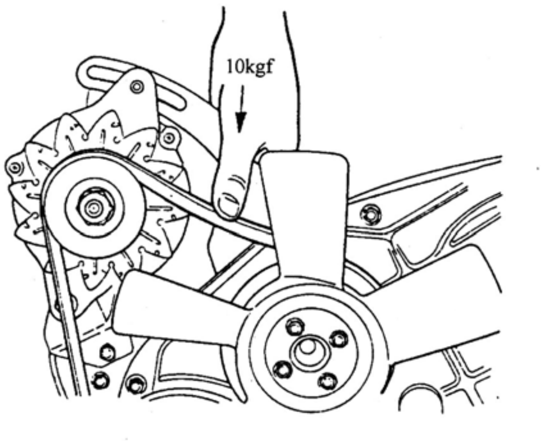


FIG.7-16

2) If the tension being out of specification, displace the generator to slacken and adjust the belt. (FIG.7-17)

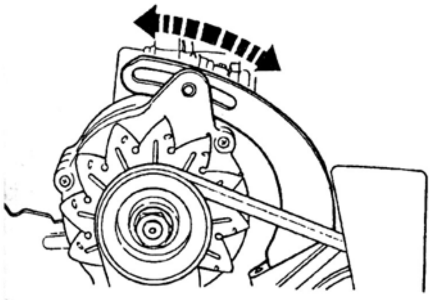


FIG.7-17

3）Tighten generator adjust bolt and pivot bolt.

4）When replacing belt，refer to above removal and installation of belt.

CAUTION

All the adjust above should be carried with the engine stopped.

2 Coolants

The coolant recovery system is standard, the coolant in the radiator expands with heat, and the overflow is collected in the reservoir tank. When the system cools down, the coolant is drawn back into the radiator. The cooling system has been filled ate the factory

Parts	Coolant Capacity (L)
Engine, Radiator And Heater	4.2
Reservoir Tank	0.6
Total	4.8

CAUTION

Alcohol or methanol base coolants or plain water alone should not be used in the cooling system at any time, as damage to the cooling system could occur.

3 Coolant level

to check the level, lift the hood and look at the “see through” water reservoir tank.

It is not necessary to remove the radiator cap to check the coolant level.

CAUTION

Do not remove the reservoir tank cap while the coolant is “boiling”

Do not remove the radiator cap while the engine and radiator are still hot.

Scalding fluid and steam can be blown out under pressure if either cap is taken off too soon.

When the engine is cool, check the coolant level in the reservoir tank. A normal coolant level should be between “full” and “LOW” marks on the reservoir tank.

4 Cooling System Service

The cooling system should be serviced as follows：

1） Check the cooling system for leaks or damage.

2） Wash radiator cap and filler neck with clean water by removing the radiator cap when engine is cold.

3） Using a pressure tester, check the system and radiator cap for proper pressure holding capacity1.1Kg/cm2. if replacement of cap is required, use the proper cap specified for this vehicle.

4） Tighten hose clamps and inspect all hoses, replace hoses whenever cracked swollen or otherwise deteriorated.

5） Clean frontal area of radiator core.

5 Coolant Filling And Drain System

Tighten radiator drain plug, and install reservoir tank.

1） Tighten thermostat air bleed bolt, and fill radiator to the neck(FIG.7-18)。

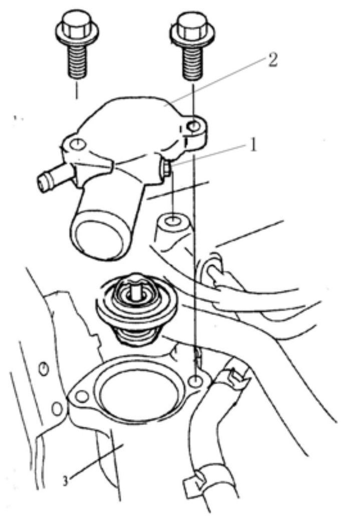


FIG.7-18

1、Thermostat air bleed bolt 2、Thermostat cap tat cap

2） Loosen the thermostat air bleed bolt to drain air.（repeat this step 3 times until the coolant drain from air bleed bolt）After draining the air, tighten thermostat air bleed bolt and fill coolant into radiator.

CAUTION
Replace new air bleed bolt washer after draining air. Tightening torque：3.0N • m(31kgfcm)。

3） Fill radiator and reservoir tank to the “FULL” level mark. Insert the heater air bleed hose and install radiator cap and reservoir cap(FIG.7-19).

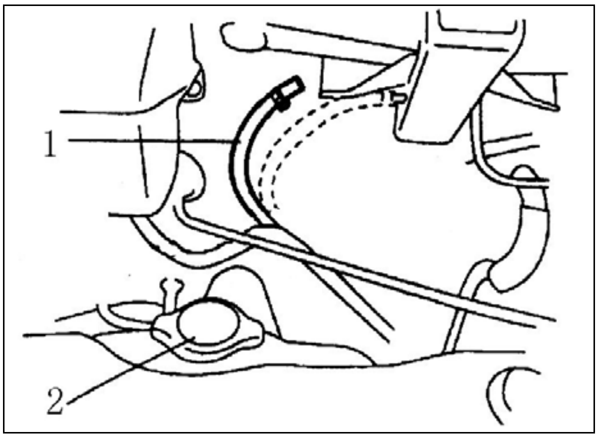


FIG.7-19

1、The heater air bleed hose

4） Run the engine with the rotate speed of 2000rpm and over until the fan runs.

5） With the engine cool, add coolant to radiator and reservoir tank.

CAUTION

Be sure to tighten radiator cap.

6 Cooling System Flush

1）Drain coolant.

2）Fill cooling system with clean water.

3）Run the engine until the thermostat is open.

4）Repeat above steps several times until the drained liquid is nearly colorless

5）Remove the tank and clean the inside of the tank with water.

6）Install reservoir tank. fill cooling system referring to cooling system refill and drain .

8 INTAKE AND EXHAUST SYSTEM

8.1 AIR CLEANER

In the air cleaner case, a dry-type air cleaner element is installed. Check the dirty and dusty element periodically, clean it according to section 2.3, and pay attention to the followings:

(1) Take out the air cleaner element from the air cleaner shell. (FIG.8-1)

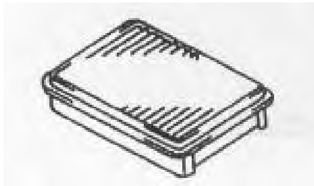


FIG.8-1

(2) Blow off dust with compressed air from inside of the element. (FIG.8-2)

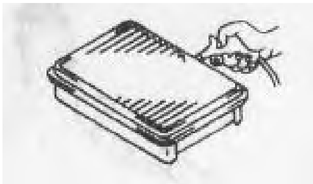


FIG.8-2

CAUTION

If the element is seriously dirty, wash it with detergent, then rinse detergent off the element and dry it with compressed air. (FIG.8-3)

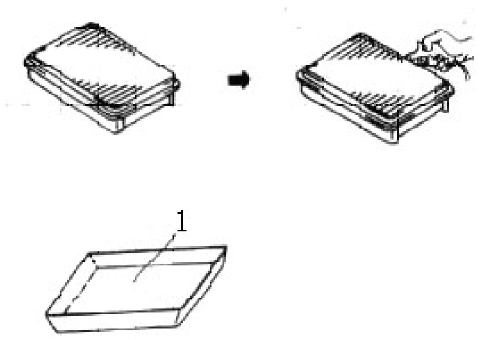


FIG.8-3

1-Family scour

8.2 EXHAUST SYSTEM

1 general description

The exhaust system consists of an exhaust manifold, TWC、muffler,、gaskets、Sealing ring、hanger etc，(FIG.8-4)

CAUTION

To avoid the danger of being burned, do not touch the exhaust system when the system is hot. Any service on the exhaust system should be performed when the system is cool.

2 Inspections

when carrying out the periodic maintenance, check the exhaust system as follows：

（1）check the hanger for damage, deterioration, and out of position.

（2）check the exhaust system for leak, loose connections, damage.

（3）check the nearby body areas for damaged, missing, or mispositioned parts, open seams, holes, loose connections or other defects which could permit exhaust fumes to seep into the car.

（4）make sure that the exhaust system components have enough clearance from the underbody to avoid overheating and possible damage to the floor carpet.

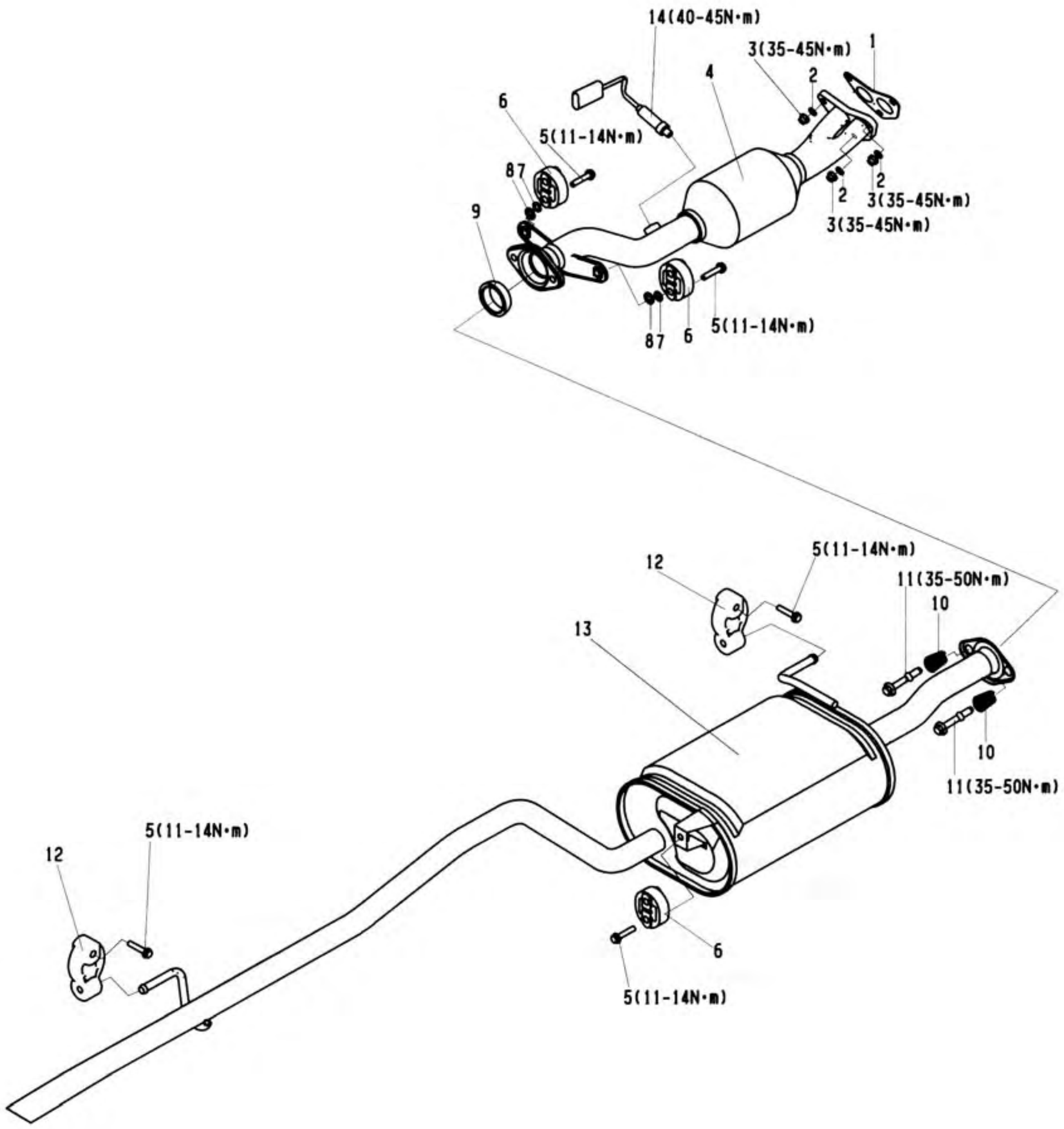


FIG.8-4

1-Gasket; 2-Light spring washer; 3-Nut hex head self-locking; 4-Connecting pipe and twc; 5-Bolt washer assy; 6-Front hanger compl; 7-Heat-insulated gasket; 8-Plate;

9- Sealing ring; 10- Spring; 11- Bolt; 12- Rear hanger compl; 13- Muffler assy.; 14- O2-sensor

3 On car service

When the exhaust manifold is removed, check the gasket and seal for deterioration or damage. Replace them as necessary.

Tighten the bolts and nuts to the specified torques when reassembling (FIG.8-4)。

Go to hafei automobile service station for help when servicing connecting pipe and TWC.

CAUTION

To avoid unburned gas mixture sucks into the catalytic, because such gas mixture HC and CO can damage the catalytic by overheating. Pay attention to the followings and avoid them during maintenance.

1) Long time idling.
2) Engine timing is not correct (delay)
3) Individual spark is out of work.
4) Valve clearance is too small.
5) Long time start engine without connecting high tension cable.
6) Run engine without connecting ignition switch.
7) Long time run fuel pump without ignition.
8) Reasons for thick air-fuel: disabled O_2 sensor, disabled fuel pressure regulator (Pressure is too high), fuel leakage form injector, sensor of throttle valve position is out of work ect.

9. ENGINE ELECTRICAL
9.1 IGNITION SYSTEM

1. GENERAL DESCRIPION

The ignition system of the vehicle which uses BOSCH M7.9.7 Engine Manager System is shown in Fig.9-1. The system is mainly comprised of the following components: spark plugs, crank position sensor, cam position sensor ignition coil, engine- ECU and power supply etc.

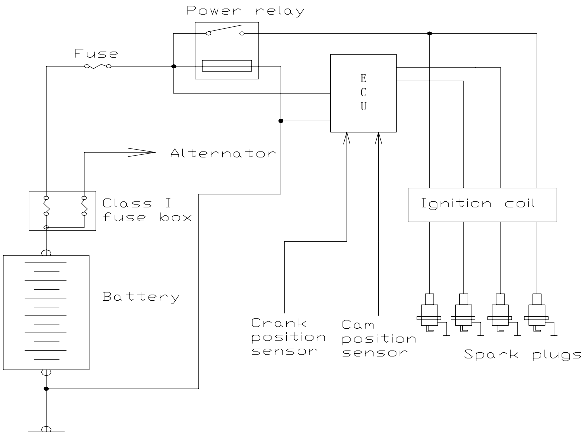


Fig. 9-1 Ignition system diagram (M 7 of UAES)

> NOTE
> How to connect the poles is shown clearly in the Fig. 9-1. Use the figure for reference to check connectors for breaks and cords for crack or deterioration and earth.

The ignition system of the vehicle which uses DELPHI Engine Manager System is shown in Fig.9-2, The system is mainly comprised of the following components: spark plug, crank angle sensor, ignition coil, engine- ECU and power supply etc.

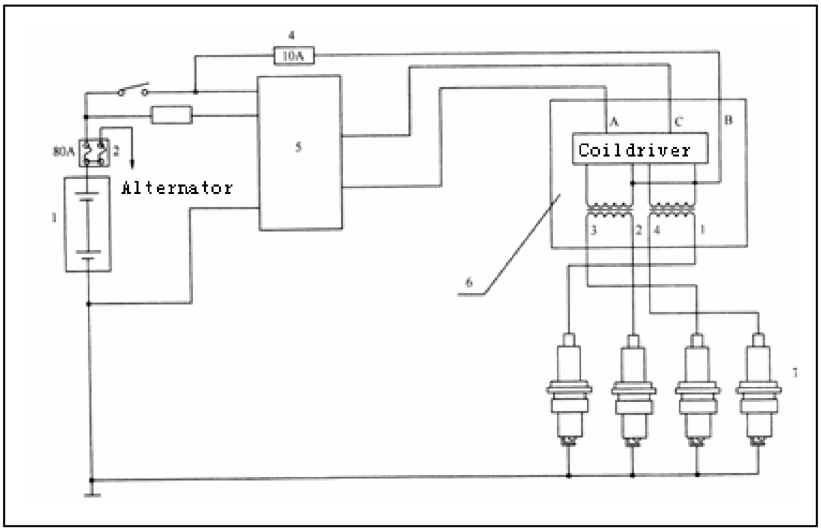


Fig. 9-2 Ignition system diagram（DELPHI）

1-Battery；2-Class I fuse box；3-Ignition switch；4-Fuse；5-Engine-ECU；6-Ignition coil；7-Spark plugs

NOTE

How to connect the poles is shown clearly in the Fig. 9-2. Use the figure for reference to check connectors for breaks and cords for crack or deterioration and earth.

2. DESCRIPTION FOR IGNITION SYSTEM COMPONENTS

- **IGNITION COIL**

ZS-K2×2 type ignition coil is comprised of tow primary windings, tow secondary windings, a core and a house. When earth terminal of one primary windings ground, the primary windings is charged; once the primary circuit is cut off by engine-ECU, charge stops; and high voltage is induced on the secondary windings, which makes spark on the spark plug.

.

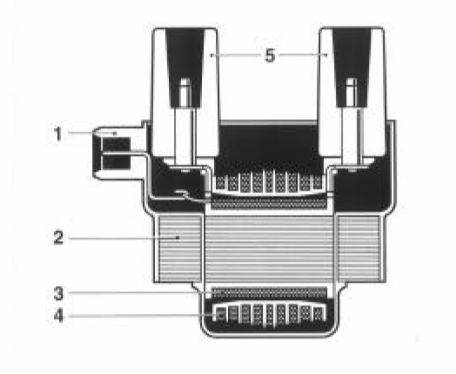


Figure 9-3 .Double ignition coil

1-Low voltage terminal；2-Core ；3-Primary windings；4-Secondary windings；5-Pole for high-tension cord

- **SPARK PLUG**

Replace spark plugs every 10000km or whenever spark plug damaged. Use same kind of spark plug when replacing. There are three kinds of coil and the types are .F6RTC(thread ; M14×1.25), DK7RTC (thread ; M14×1.25) and DF7REC2(thread ; M12×1.25).

Keep the surface clean and no carbon deposits between electrode outside electrode and insulator of the spark plug center electrode. Clean the surface with thin sand paper if carbon deposits is found.

Clearance of spark plug is 0.8～1.0mm（DF7REC2）or 1.0～1.2mm（F6RTC, DK7RTC）（Figure 9-4）, the clearance is homogeneous on the whole surface of the whole center electrode.

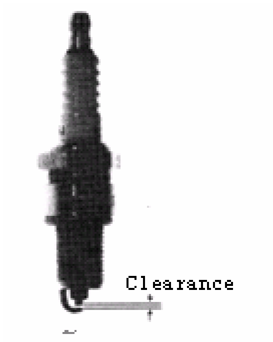


Fig.9-4

3. IGNITION TIMING

Ignition advance is controlled by engine-ECU, for vehicle used BOSCH or DELPHI Engine Manager System, so no adjusting needs.

9.2 CRANKING SYSTEM

1. GENERAL DESCRIPITION

● CRANKING CIRCUIT

The cranking circuit consists of the battery, starting motor, ignition switch, and related electrical wiring. The components are connected electrically as shown in Fig. 9-5. Only the starting motor will covered in the portion.

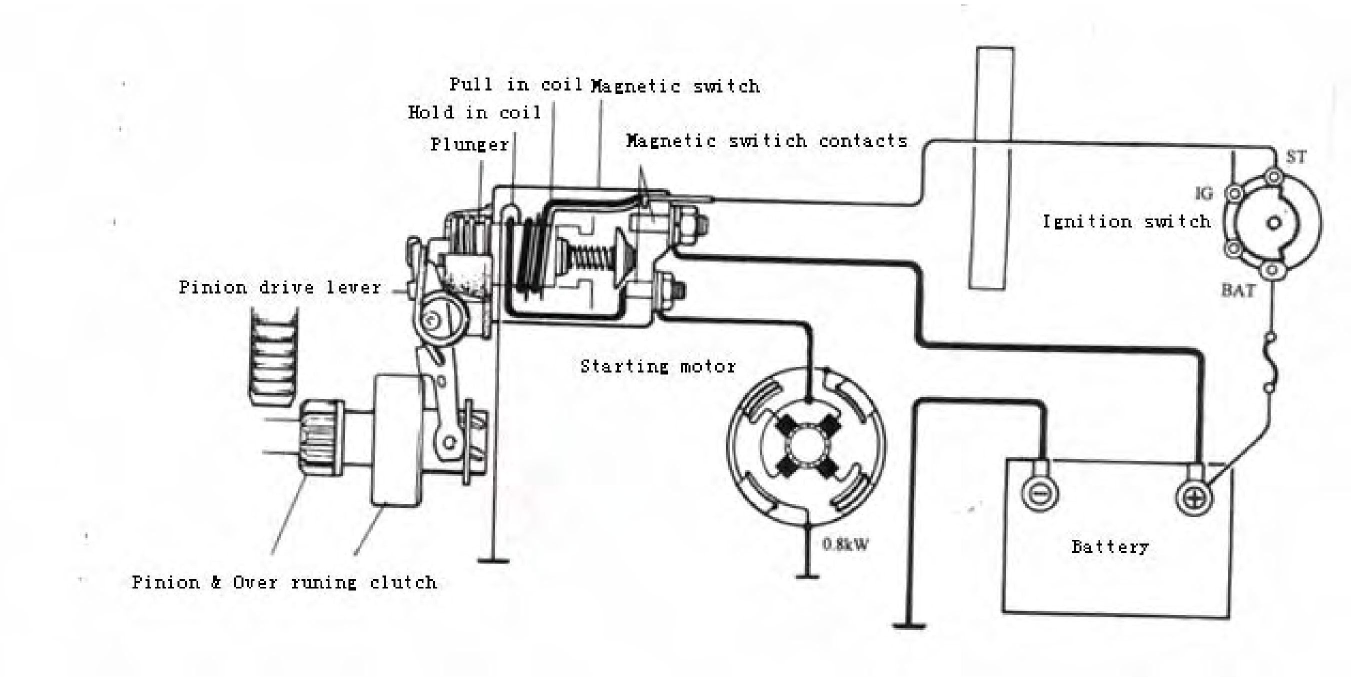


Fig. 9-5

● STARTING MOTOR

The starting motor consists of the parts shown in Figure 9-6 and has field coils mounted in starting motor yoke (frame).

The magnetic switch assembly and pars in the starting motor are enclosed in the housing s so that they will be protected against possible dirt and water splash.. In the circuit shown in Fig. 9-7, The magnetic (motor) switch coils are magnetized when ignition switch is closed. The resulting plunger and pinion drive lever movement caused the pinion to engage the engine flywheel gear and the magnetic switch main contacts to closed, and cranking takes place. When then engine starts, the pinion overrunning clutch protects the armature from excessive speed until the switch is opened, at which time the return spring causes the pinion to disengage.

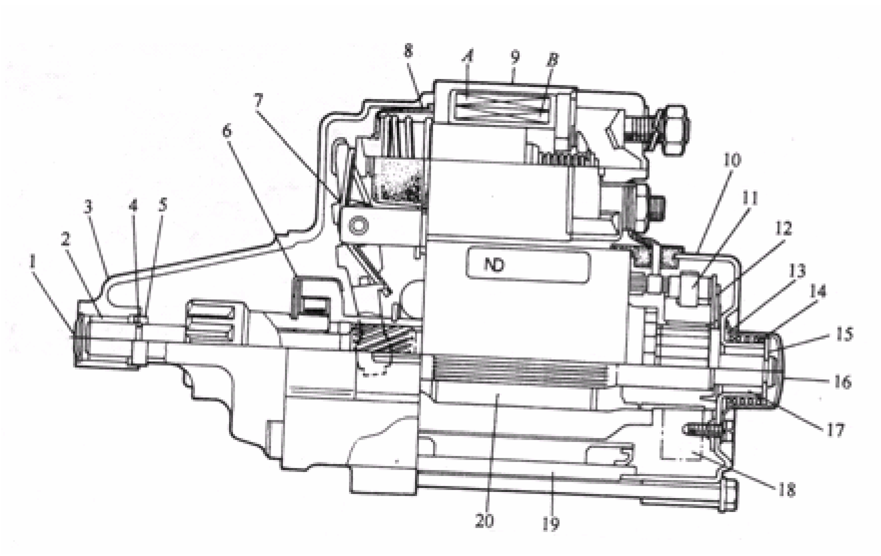


Fig. 9-6

!- Dive housing cover; 2-Drive bushing; 3-Drive housing; 4-Armature ring; 5-Armature stop ring; 6- Over running clutch; 7-Pinion drive lever; 8-Switch cover; 9-Magnetic switch; 10-Comutator end housing; 11-Brush spring; 12-Brush holder; 13-End cap gasket; 14-Armature brake spring; 15-Armature plate; 16-Commutator end cap; 18- Brush; 19- Starting motor yoke; 20-Armature; A-Hold in coil; B-Pull in coil.

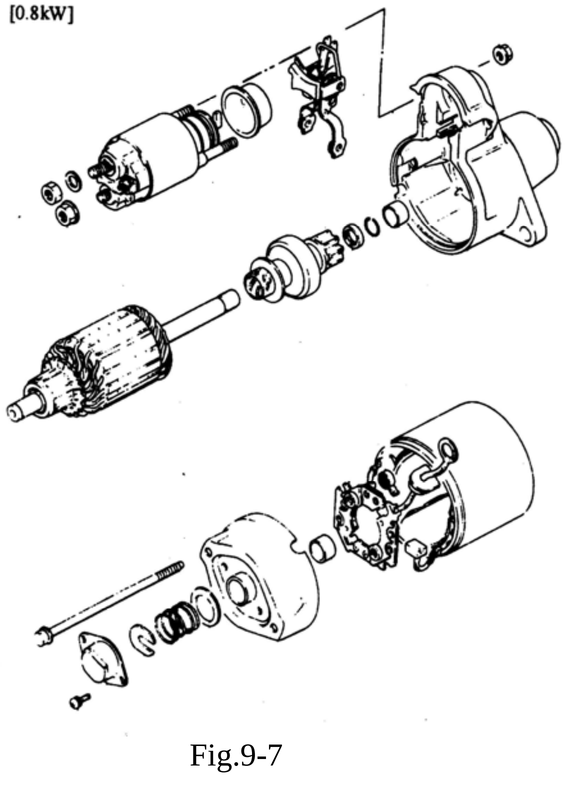


Fig.9-7

2. SPECIFICATION (Table 9-1)

Table 9-1

Rated voltage	12V
Output power	0.8KW
Starting period	30s
Direction of rotation	counterclockwise as viewed from driving pinion side
Length of brush	16mm
Number. of pinion teeth	8
No-load charateristic	At 11V, max. 50A, more than 5000r/min,.
Load charateristic	At 9.5V, max.270A, torque: 5N/m, more than .2000r/min,
Locked rotor current	At 7.7V, max. 600A torque: 13N.m,
Magnetic switch operating voltage	max.8V ,

3. LUBRICATION

Staring motors do not require lubrication except during overhaul.

When the motor is disassembled for any reason, lubricate as follows.(Fig. 9-8)

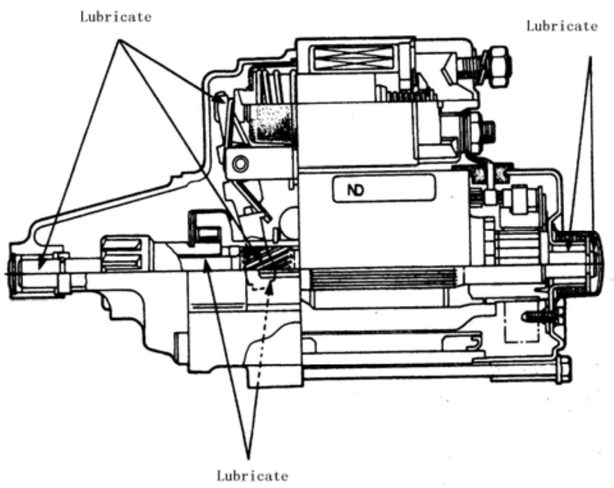


Fig 9-8

4. REMOVAL AND INSTALLATION

- **Starter (Fig. 9-9)**

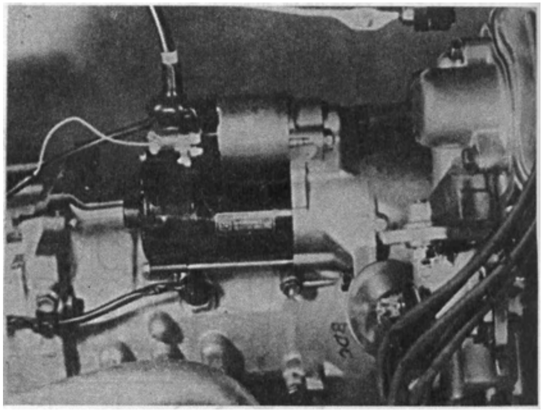


Fig. 9-9

Use the following procedure to remove starter

(1)Disconnect negative battery lead at battery.

(2) Disconnect magnetic switch lead wire(color : BY) and battery cable from starting motor terminals；

(3) Remove two starter motor mount bolts.

(4) Remove starting motor.

(5) To install, reverse the above procedure.

5. DISASSEMBLY

(1) Disconnect wire (switch to motor) from magnetic switch terminal (Fig.9-10).

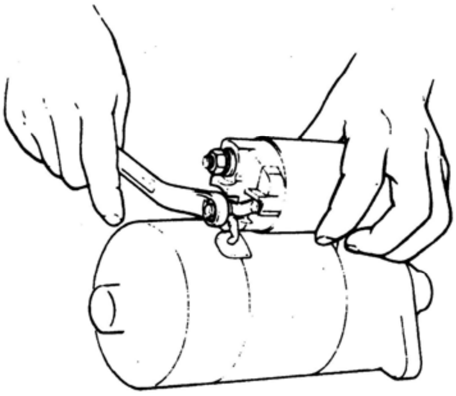


Fig. 9-10

(2) Remove magnetic switch assembly (Fig.9-11).

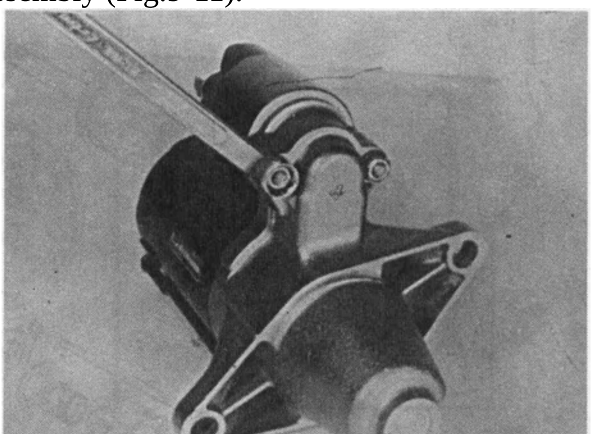


Fig. 9-11

NOTICE:

Raise terminal side of the switch to release yoke on top of move core (Fig. 9-12).

Don’t disassemble this switch. If defective, replace as complete assembly.

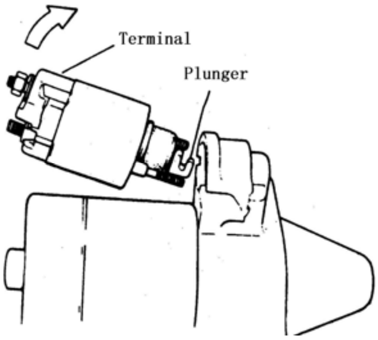


Fig. 9-12

(3) Remove commutator end cap, armature plate and spring (Fig. 9-13).

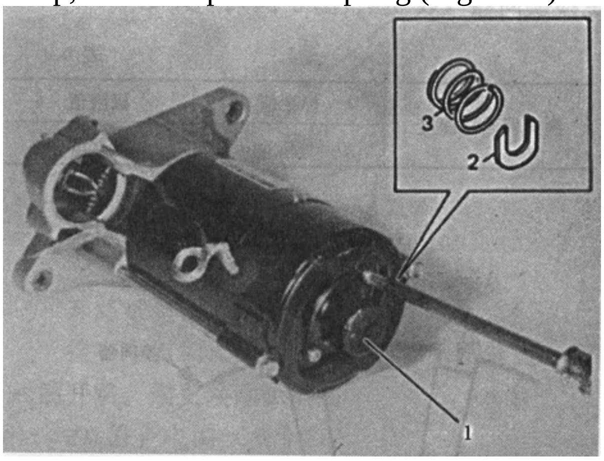


Fig. 9-13

1-Commutator end cap ; 2- Armature plate; 3- Spring

(4)Remove commutator end housing (Fig. 9-14)。

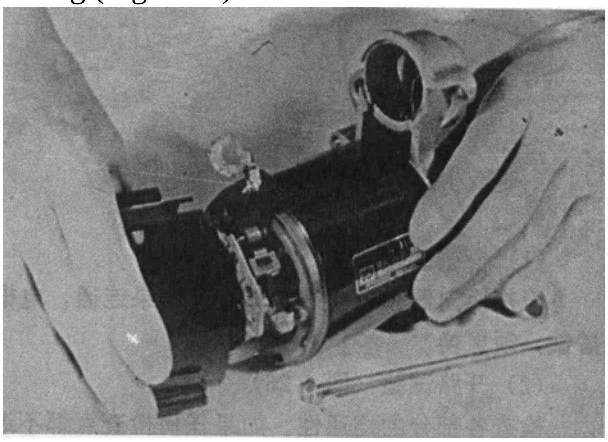


Fig. 9-14

(5) Remove brush holder and motor frame.

(6) Remove armature (Fig. 9-15).

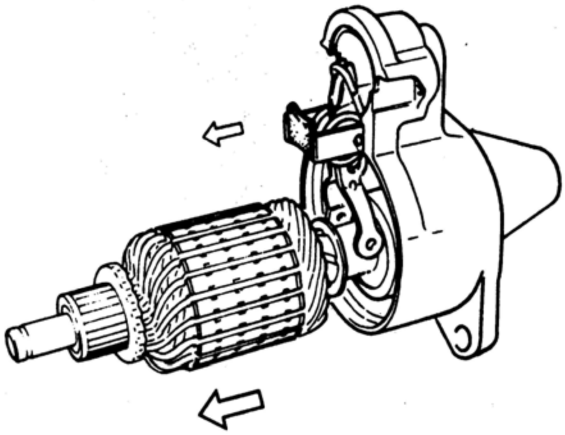


Fig.9-15

(7) Remove over-running clutch (Fig. 9-16).

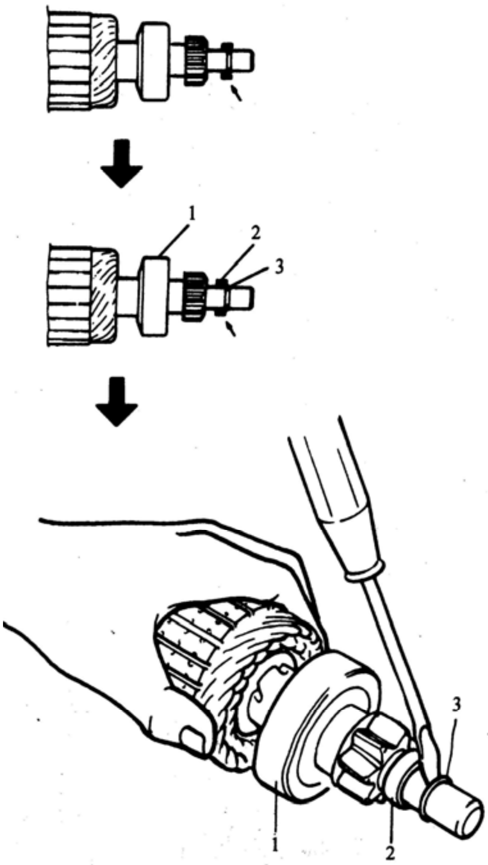


Fig.9-16

1-Over-runging ；2-Armature stop ring；3-Armature ring

(8) Remove brushes from the holder (Fig. 9-17).

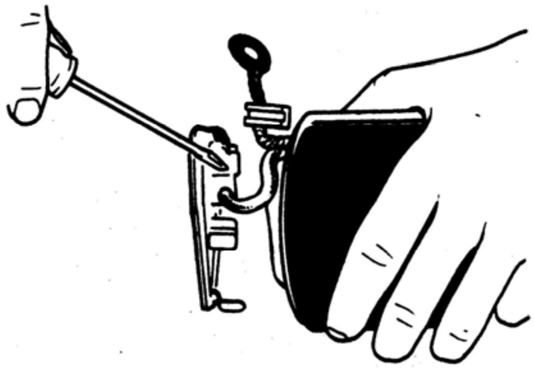


Fig.9-17

6. STARTING MOTOR INSPECTION

1) INSPECT COMMUTATOR (Fig. 9-18)

Check commutator for dirty or burnt. If necessary, correct with sand-paper or lathe.

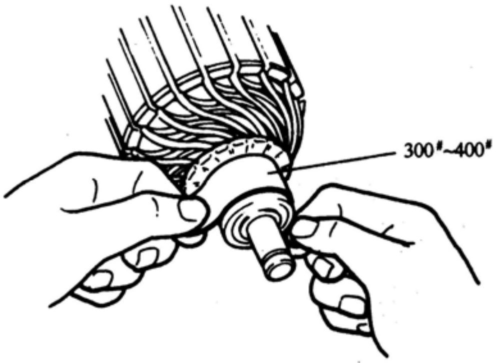


Fig.9-18

Check commutator for uneven wear. If deflection measured by dial gauge exceeds limit, repair or replace(Table 9-2, Fig. 9-19).

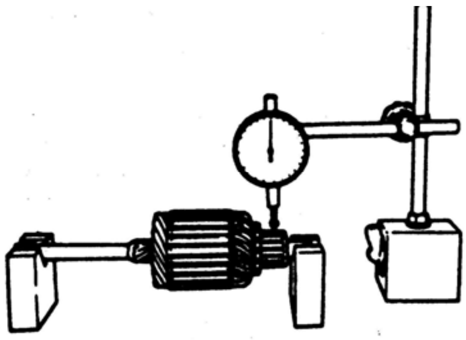


Fig. 9-19

NOTICE
Specification below is supposed that armature is free from bend. Bent shaft must be replaced.

Table9-2

Commutator out of round	Standard	Limit
	0.05mm	0.4mm

Inspect commutator for wear. If below the limit, replace armature (Table 9-3, Fig. 9-20).

Table9-3

Commutator outside diameter	Standard	Limit
	28mm	27mm

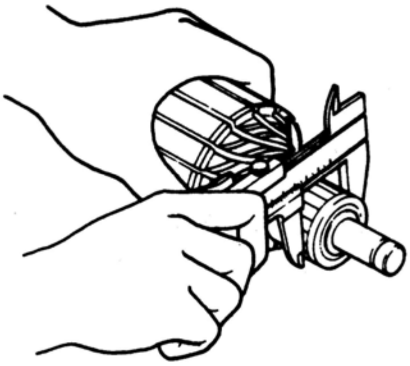


Fig. 9-20

Inspect commutator for mica depth. Correct or replace if below the limit (Table 9-4, Fig. 9-21).

Table 9-4

Commutator mica depth	Standard	Limit
	0.5~0.8mm	0.2mm

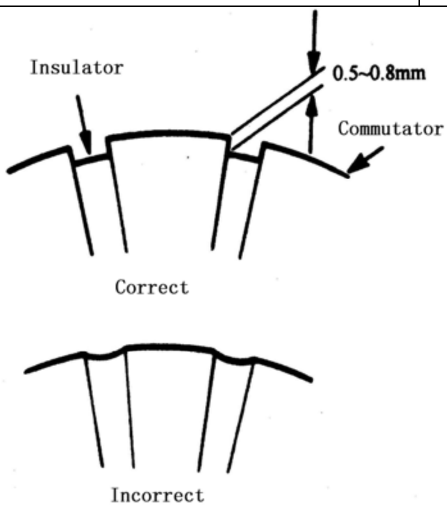


Fig. 9-21

(1) Ground test (Fig. 9-22)

Check commutator and armature coil core. If there is continuity, armature is grounded and must be replaced.

(2) Open circuit test (Fig. 9-23)

Check for continuity between segments. If there is no continuity at any test point, there is an open circuit and armature must be replaced.

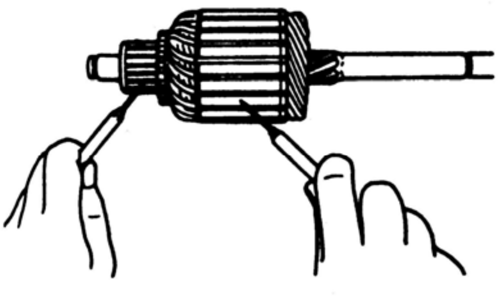


Fig. 9-22

Fig. 9-23

2) INSPECT FIELD COIL (Fig. 9-24)
Open circuit test:
Check the continuity between brush and bare surface. If there is no continuity, field windings are open-circuited. The field coil must be replaced.
3) INSPECT BRUSH (Fig.9-25)
Measure length of brush. Check brush for wear. If below limit, replace brush (Table 9-5).


Fig. 9-24

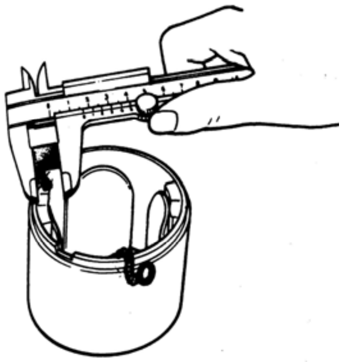


Fig. 9-25

Table 9-5

Brush length	Standard	Limit
	16mm	10.5mm

4) **INSPECT BRUSH HOLDER AND SPRING**
Check movement of brush on brush holder. If brush movement on brush holder is sluggish, check brush holder for distortion and sliding faces for contamination.
Clean or correct if necessary.
Check for continuity across insulated brush holder (positive side) and grounded brush holder (negative side).
If continuity, brush holder is grounded due to defective insulation and should be replaced (Fig 9-26).
Inspect brush springs for wear, damage or other abnormal conditions. Replace if necessary (Table 9-6、Fig. 9-27).

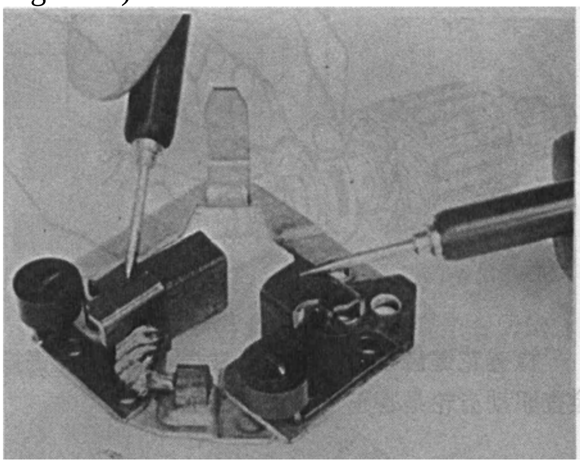


Fig. 9-26

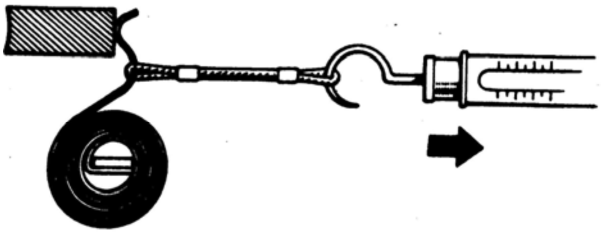


Fig. 9-27

Table 9-6

Brush spring tension	Standard	Limit
	1.6kgf	1.0kgf

5) INSPECT DRIVE LEVER (Fig.9-28)

Inspect drive lever and springs for wear. Replace it if necessary.

6) INSPECT DRIVE PINION (Fig. 9-29)

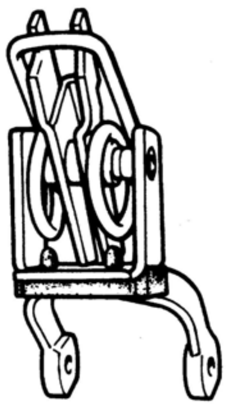


Fig. 9-28

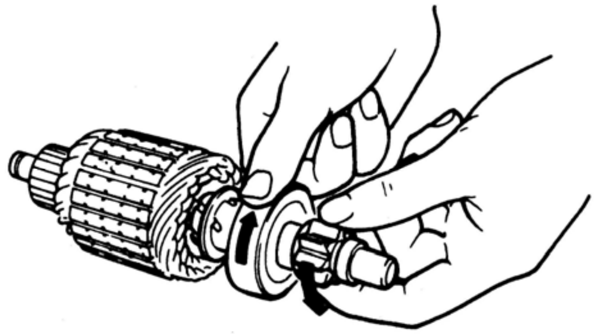


Fig. 9-29

Inspect drive pinion for wear, damage or other abnormal conditions. Check the clutch for lock up when turned in drive direction and rotates smoothly in reverse direction. Replace if necessary.

Inspect spline for wear or damage, Replace if necessary.

Inspect pinion for smooth movement (Fig.9-30) .

7) INSPECT ARMATURE SHAFT BUSHING(Fig.9-31)

Inspect the bushing for wear or damage. Replace if necessary.

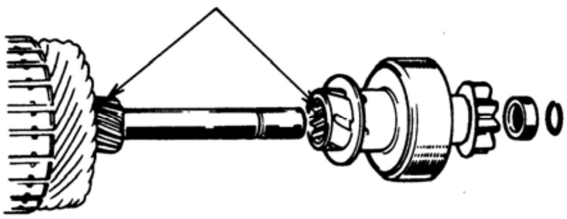


Fig. 9-30

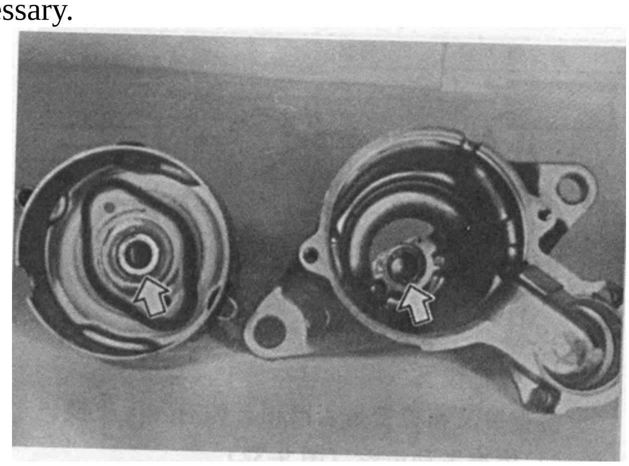


Fig. 9-31

8) INSPECT MAGNETIC SWITCH(Fig.9-32)

Inspect magnetic switch boot for breakage and its plunger for wear or damage. Replace if necessary.

Push plunger in and release it. The plunger should return quickly to its original position. Replace if necessary (Fig 9-33).

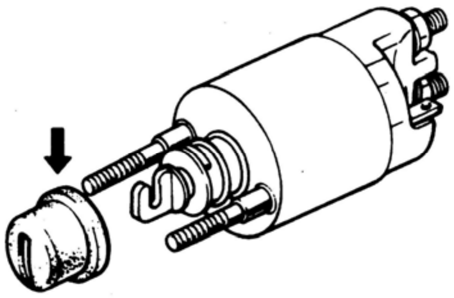


Fig. 9-32

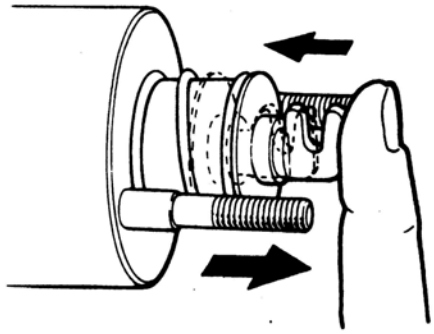


Fig. 9-33

(1) Pull-in coil open circuit test

Check for continuity across magnetic switch ‘S’ terminal and ‘M’ terminal. If no continuity, the coil open and should be replaced (Fig.9-34).

(2) Hold in coil open circuit test

Check for continuity across magnetic switch ‘S’ terminal and coil case. If no continuity exits, the coil is open and should be replaced (Fig.9-35).

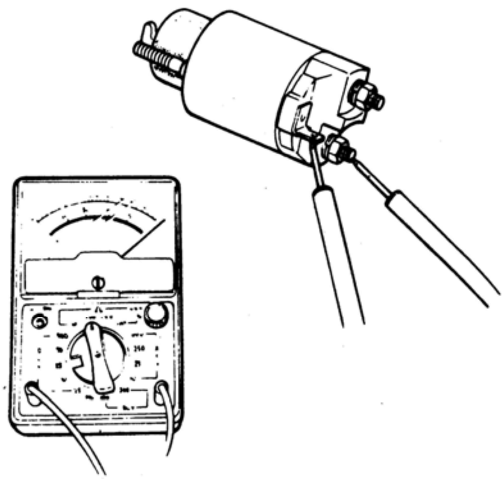


Fig.9-34

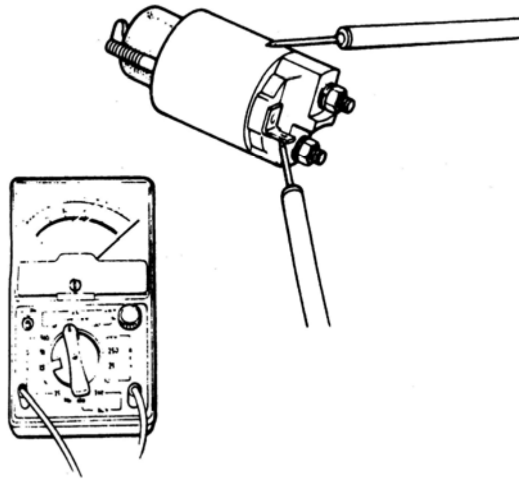


Fig. 9-35

7. PERFORMANCE TEST

NOTICE
These tests must be performed within 3 – 5 seconds to avoid burning out the coil.

1) Pull-in test

Connect battery to magnetic switch as shown in Figure 9-36. Check that plunger moves outward.
If the plunger does not move, replace magnetic switch.

2) Hold-in test

While connected as above with plunger out, disconnect negative lead from terminal M. Check that plunger remains out (Fig. 9-37).

If the plunger remains in, replace magnetic switch.

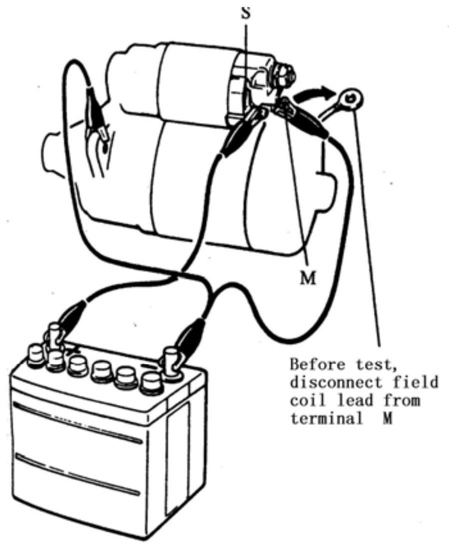


Fig.9-36

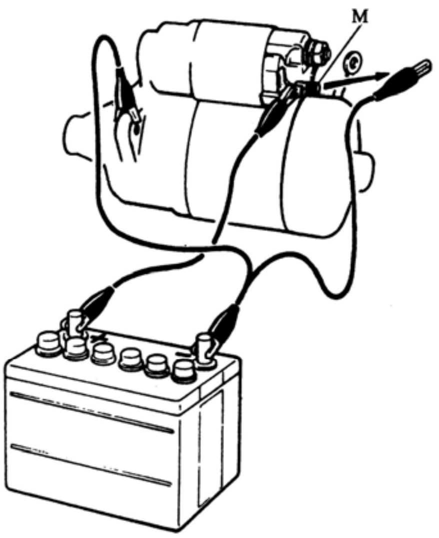


Fig. 9-37

3) Check plunger return (Fig.9-38)

Disconnect negative lead from switch body. Check that plunger returns inward.

If plunger does not return, replace magnetic switch

4) No-load performance test

(1) Connect field coil to terminal M.

(2) Connect battery and ammeter to starter as shown in Fig.9 -39.

(3) Check that starter rotates smoothly and steadily with pinion moving. Check ammeter readings .The specified current sees Table 9-7.

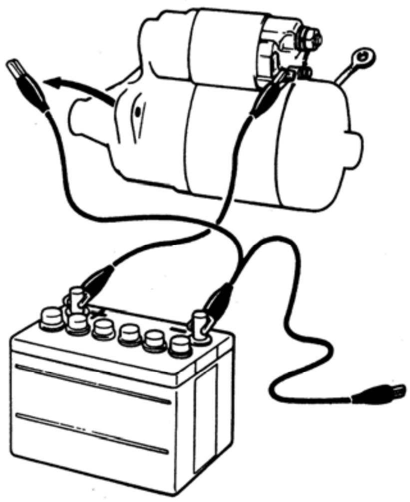


Fig.9-38

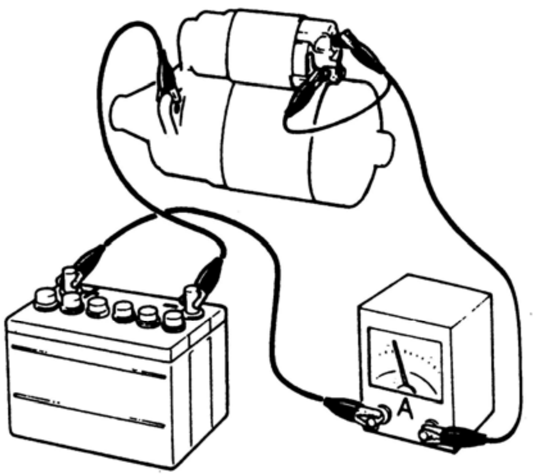


Fig. 9-39

Table 9-7

Specified current	Less than 50A at 11V

9.3 CHARGING SYSTEM

1. ALTERNATOR

●GENERAL DESCRIPTION (Fig. 9-40)

The basic charging system is the IC integral regulator charging system. The internal components are connected electrically as shown in Fig. 9-41.

The alternator features a solid state regulator that is mounted inside the alternator. All regulator components are enclosed into a solid mold, and this unit along with the brush holder assembly is attached to the slip ring end frame. The regulator voltage setting cannot be adjusted

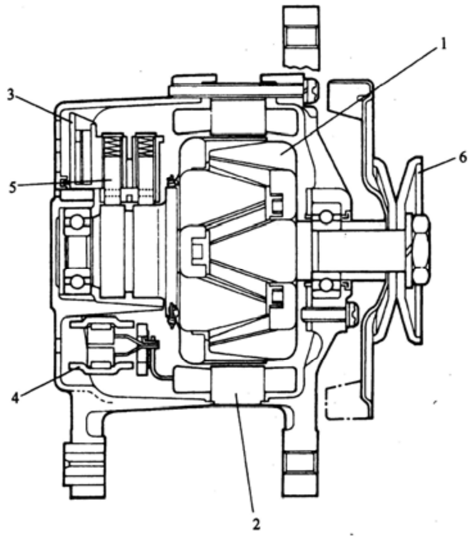


Fig.9-40

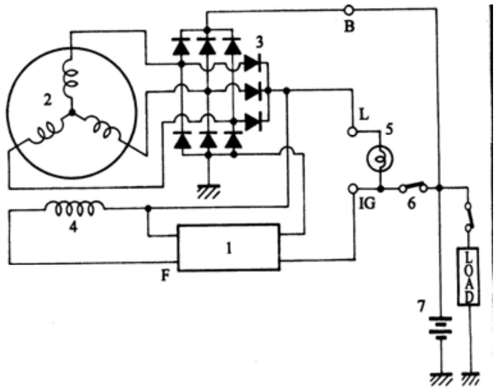


Fig. 9-41

1-Rotor ； 2-Stator Field coil； 3- IC regulator；
4-rectifier；5- Brush；6- Pulley

Table 9-8

Nominal operating voltage	12V
Max. alternator output	65A
Polarity	Negative ground
Diameter of pulley	65mm
No-load alternator speed	1000~1100r/imn ， at 14V and standard temperature ，
Full-load alternator speed	5000r/min, at 13.5V , Max. load 65A and standard temperature,
Direction of rotation	Clockwise as viewed from pulley side
Maximum permissible alternator speed	13500r/min
Rectification	Full wave rectification

●DIAGNOSIS

When an alternator with built-in regulator has troubles, or when charging indicator lamp lights with engine running, inspect charging system as following procedures below.

1. Fig. 9-42
At idling, measure voltage of B terminal. Raise engine to about 2000 r/min and measure voltage of B terminal. Comparing the tow values, check whether the voltage at 2000 r/min is higher than that at idling.

Higher (OK) to 6

Not (NG)

2. Fig. 9-43
Stop engine. Turn ignition switch ON. Measure voltage of L terminal, with connector and B terminal connected.

0 – 1V

Near battery voltage

To 5

2 -3V

To 6

3. Fig. 9-44
Connect terminal B to terminal IG with a jump lead. Do as 2 step (with connector and terminal B connected).

OK

NG

Harness (or ignition switch) poor

4. Fig. 9-45
Disconnect alternator. Check terminals L, IG of alternator for continuity.

Continue
* IC regulator damage
* Terminal L ground

Not continue
* IC regulator damage

The Voltage is lower than the standard
* Check IC regulator
* Check alternator

The Voltage is in the range of standard
*IC regulator well

The Voltage is higher than the standard.
*IC regulator damaged

Check alternator

Check rectifier and solenoids for continuity and short circuit. If it is verified that rectifier and solenoids have no abnormal phenomena, IC regulator must damage.

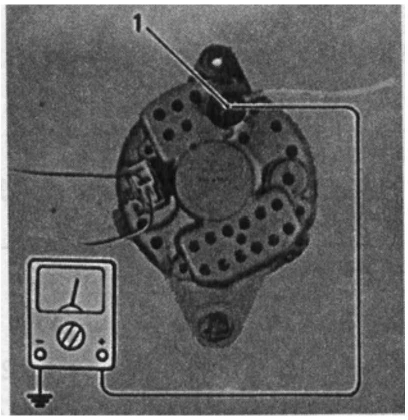


Fig.9-42

1- Terminal B

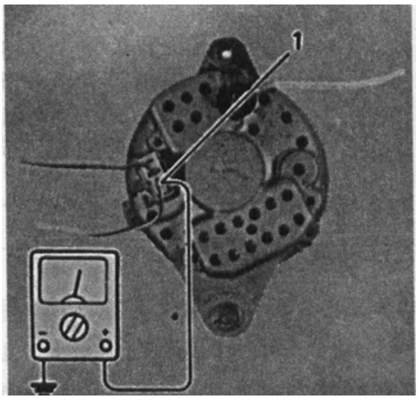


Fig.9-43

1- Terminal L

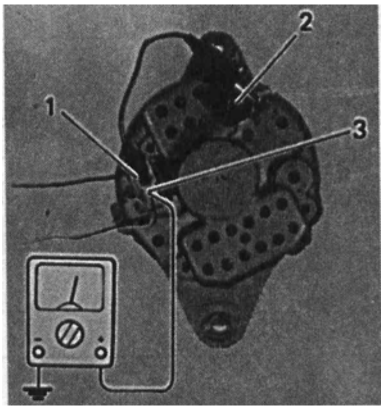


Fig.9-44

1- Terminal IG；2- Terminal B 3- Terminal B

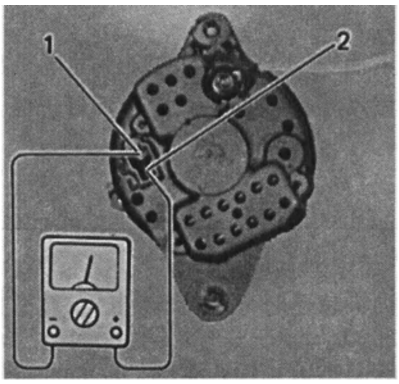


Fig.9-45

1- Terminal IG；2- Terminal L

NOTE

- Check belt tension and connector connecting;
- Use a full-charge battery.

CAUTION

Inspect voltage of terminal F. Put positive probe of tester on terminal F through the hole for terminal. If the probe contacts alternator house, which may ground, do not measure the voltage. So carefully be sure that the probe does not contact the house. As soon as the probe contacts the house, take out the probe from the house immediately

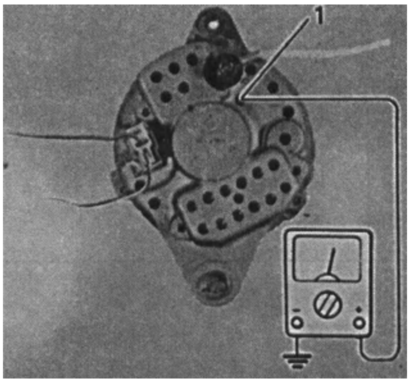


Fig. 9-46

1-Hole for terminal F

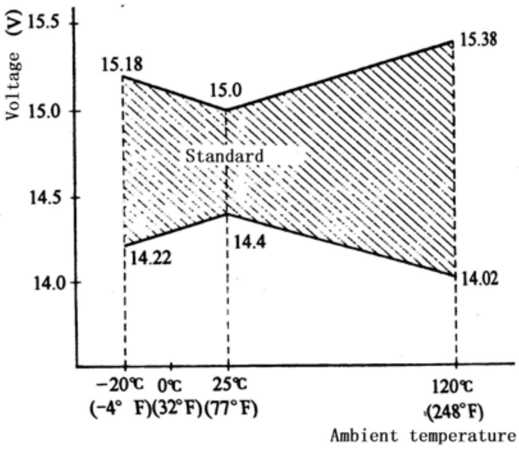


Fig. 9-47

1-Voltage；2-Standard；3-Ambient temperature

●ALTERNATOR SERVICE

1) REMOVAL

(1) Disconnect battery negative cable from the battery (-) terminal.

(2) Disconnect the alternator lead wire.

(3) Remove the alternator drive belt, adjusting bolt and alternator mounting bolts;

(4) Remove the alternator.

2) Disassembly (Fig. 9-48)

(1) Remove 3 bolts fastening end frame to rotor housing; tap on rotor housing with a wooden mallet to separate stator and rotor housing from end frame and motor (Fig.9-49).

(2) Fix the rotor with vise. Release nuts. Remove pulley, fan and end frame (Fig.9-50). (3) Remove 3 screws securing rectifier holder in place, and one other nut holding down terminal insulator. Remove rotor house (Fig.9-51)

Melt stator coil terminal-to-rectifier connecting solder with a soldering iron, and separate rectifier-IC regulator assembly from stator.(Fig9-52)

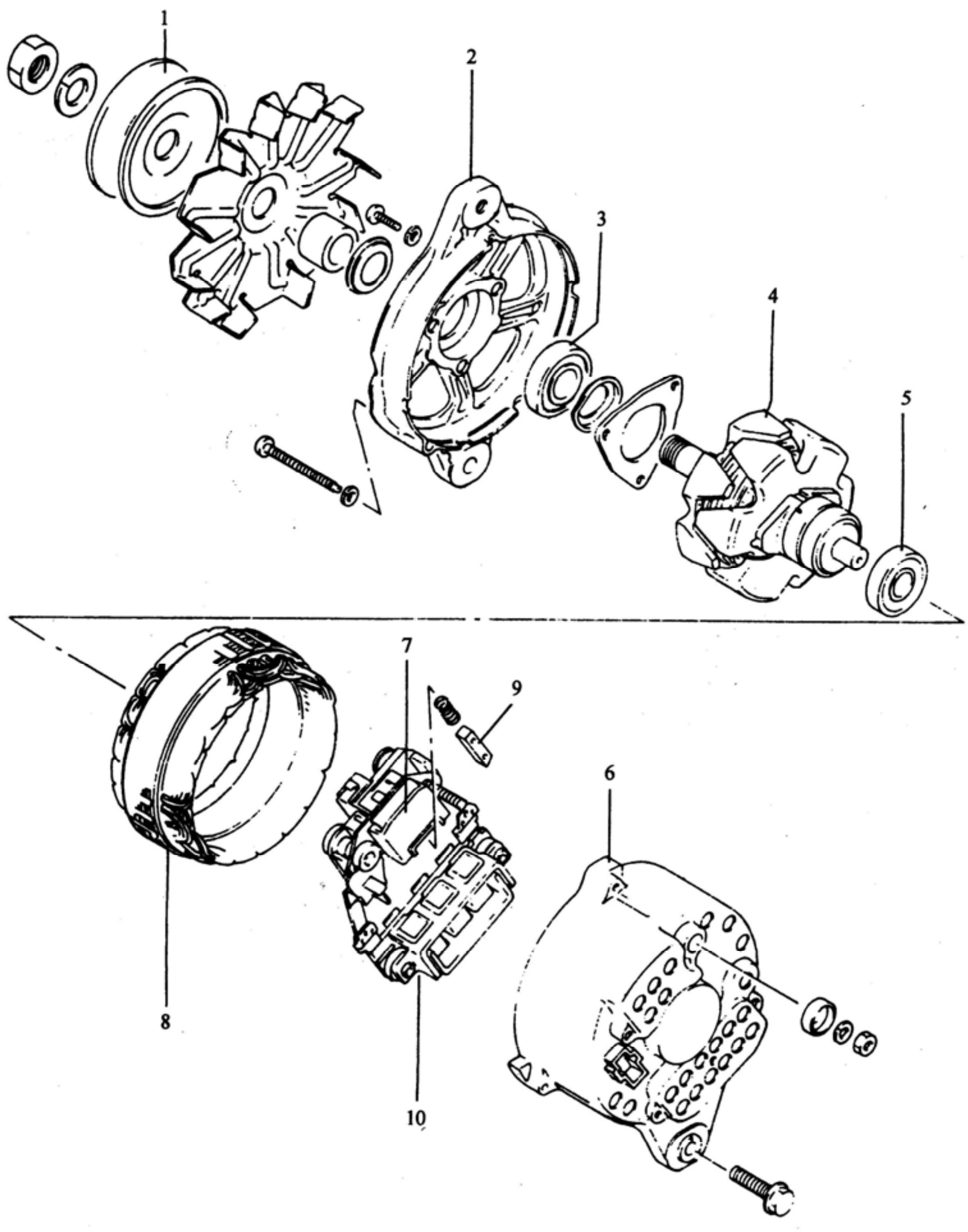


Fig.9-48

1 -Alternator pulley; 2- -drive end frame; 3- -front bearing; 4- -rotor; 5- -rear bearing; 6- -rotor housing； 7- -regulator assembly； 8- -stator assembly； 9- -brush； 10- - rectifier

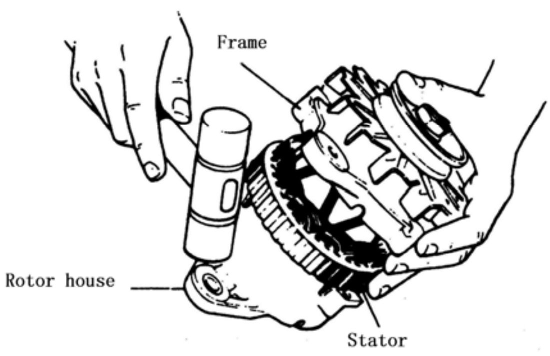


Fig.9-49

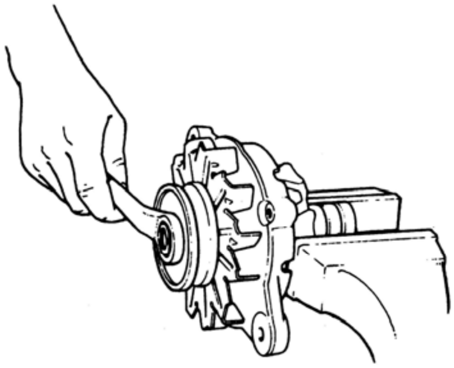


Fig. 9-50

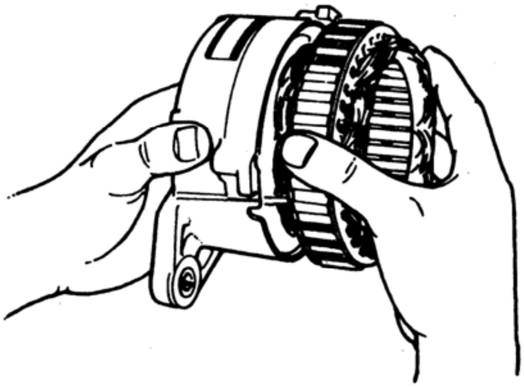


Fig. 9-51

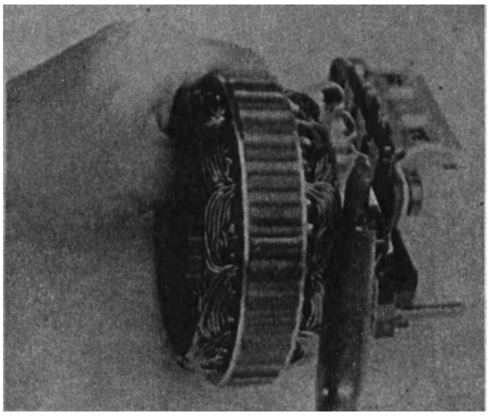


Fig.9-52

NOTE
IC regulator housing is used as brush holder; in other words, IC regulator and brush holder is integrated (Fig. 9-53)

● **INSPECTION**

1) ROTOR

(1) Check rotor for no open circuits

As shown in Fig. 9-54, check for continuity between the slip rings. If there is no continuity, the field coil open, replace the rotor.

(2) Check rotor for no grounds

As shown in Fig. 9-55, check that there is no continuity between the slip ring and the rotor. If there is continuity, the field coil insulator is crack or damage. Replace the rotor.

2) **STATOR**

Check that there is no continuity between the stator core and the coil leads. If there is continuity, replace the stator (Fig.9-56)

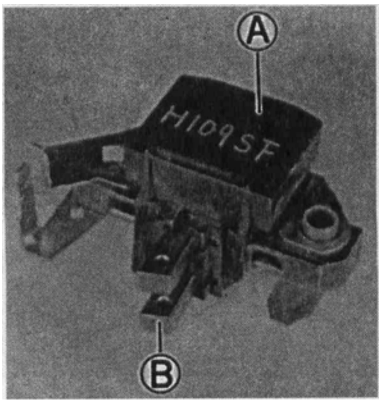


Fig.9-53
1-IC regulator；2-Brush

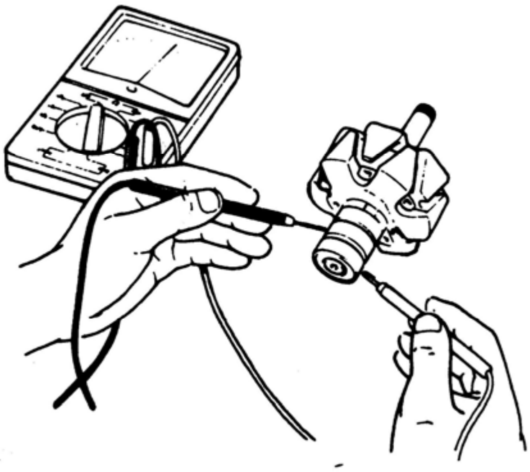


Fig. 9-54

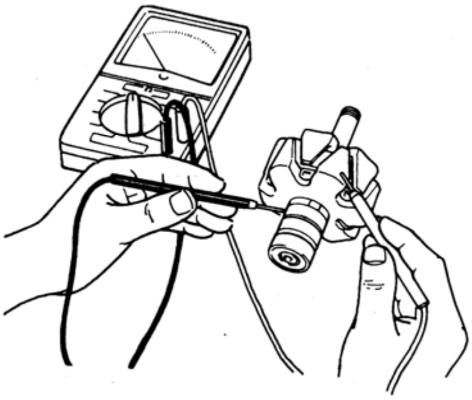


Fig. 9-55

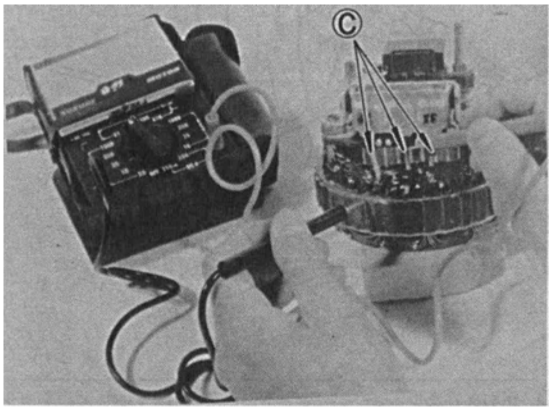


Fig. 9-56

3) Brush

Check each brush for wear by measuring its length as show in Fig.9-57. If the brush is found worn down to the service limit (Fig.9-57), replace the brush with the holder.

4) **RECTIFIER**（Fig.9-58）

(1) Check positive diodes

Using a circuit tester, check for continuity between positive side radiator and diodes (three places). Put positive probe to positive side radiator, negative probe to diode lead. The tester should show that the circuit is continuity; then check in reverse direction, which the tester should show that the circuit is no continuity. If not, replace rectifier assembly.

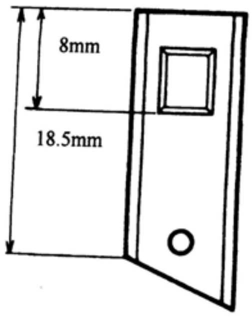


Fig. 9-57

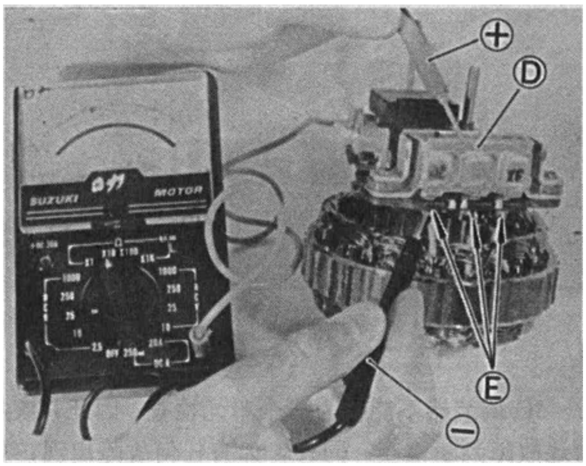


Fig. 9-58
D-Positive side radiator；E-Diode lead

(2) Check negative diodes (fig 9-59)

Using a circuit tester, check for continuity between negative side radiator and diodes (three places). Put negative probe on negative side radiator, positive probe on diode lead. The test should show that the circuit is continuity; then check in reverse direction, which the tester should show that the circuit is no continuity. If not, replace rectifier assembly

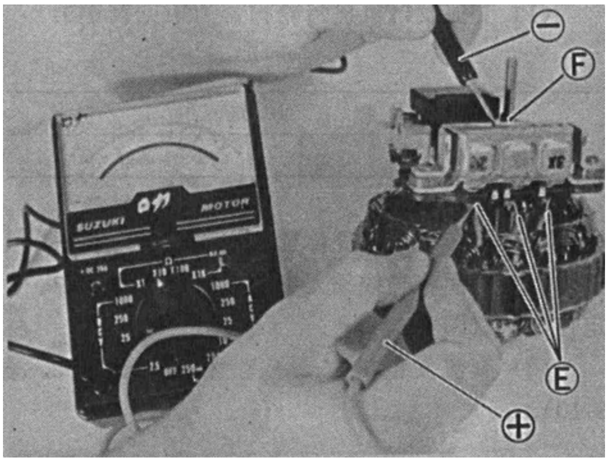


Fig. 9-59
1-Negative side radiator；2-Diode lead

(3) Check other three diodes

Check each diode of the set of diodes (total 3 diodes) for continuity in both directions. If continuity occurs only in one direction, and no continuity in the other direction, the diode should be in good condition. If not, replace that one. (Fig. 9-60).

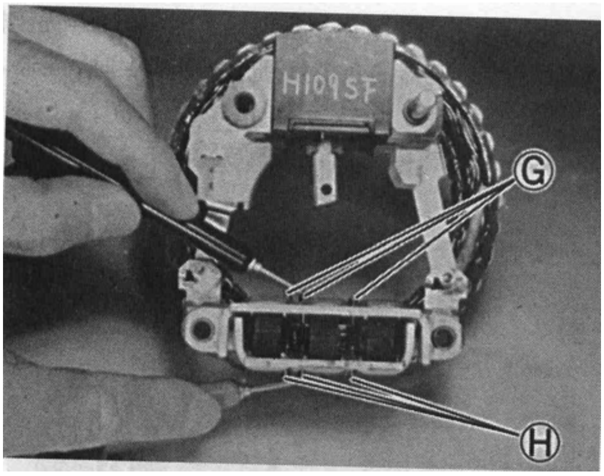


Fig. 9-60
1-Three diodes

5) **IC REGULATOR.**

IC regulator can not be check as one unit. So check for malfunction as shown before. If any faulty occurs, replace the faulty part.

● ASSEMBLY

Perform the disassembly in reverse sequence, using care on the following points.

Alternator pulley tightening torque is shown in Table 9-9.

Table 9-9

Tightening torque	45~60N.m (4.5~6.0kgf.m)

Use a press when forcing the bearing into the rotor shaft or drive end frame, insert wire into lead hole on the brush outside, fit the brush. (Fig. 9-61)

Alternator V belt tension (Fig. 9-62, Table 9-10).

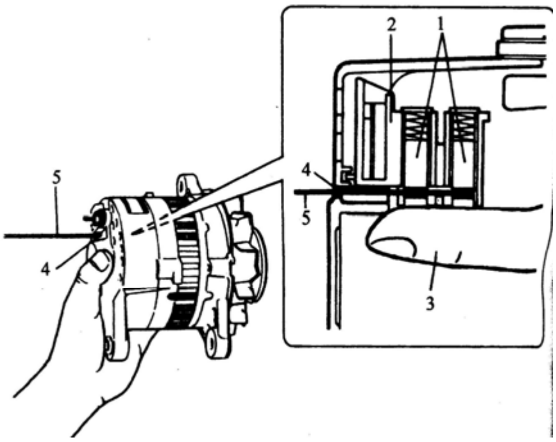


Fig. 9-61
1-Brush；2-Brush holder；3-Thumb；4-Hole for brush lead；5-Lead

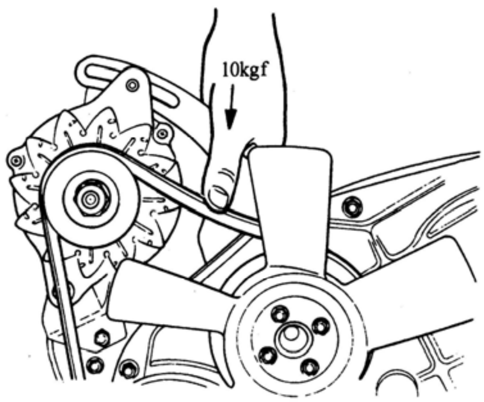


Fig. 9-62

Table 9-10

Drive belt deflection(Under 10 kg thumb pressure)	7~10mm

10 TRANSMISSIONS AND GEAR SHIFT CONTROL

10.1 TRANSMISSION

● **GENERAL DESCRIPTON**

The transmission consists of following main parts as shown in FIG.10-1.

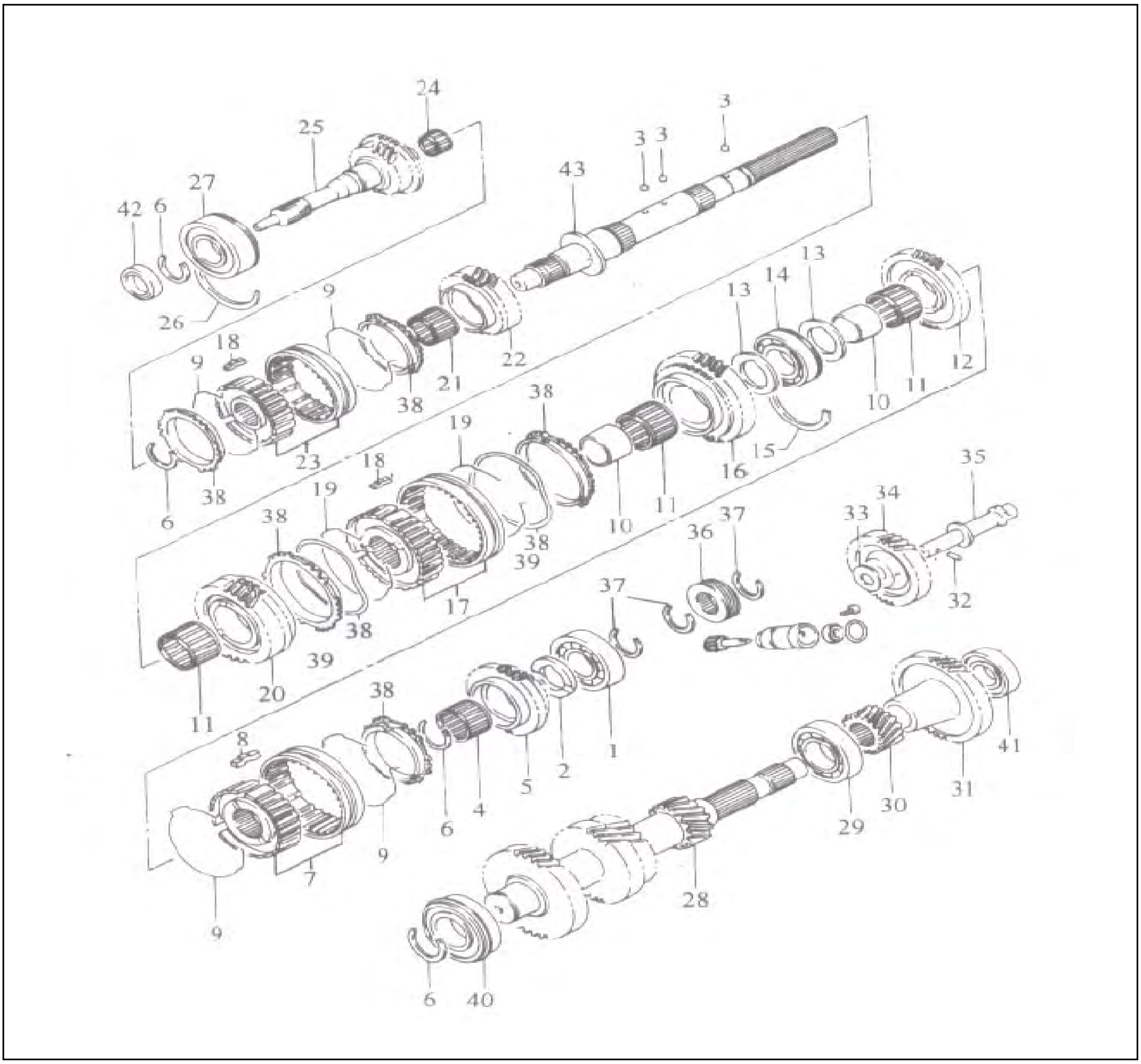


Fig 10-1

1-Main shaft rear bearing; 2-5th gear washer; 3-Main shaft washer ball; 4-5th gear needle bearing; 5-5th gear; 6-Circlip; 7-Synchronizer reverse hub set; 8-Synchronizer key; 9-Synchronizer spring; 10-Gear bush; 11-Reverse gear needle bearing; 12-Reverse gear; 13-Main shaft bearing washer; 14-Main shaft bearing; 15-C ring; 16-Low gear; 17-Synchronizer low speed hub set; 18-Synchronizer key; 19-Synchronizer spring; 20-2nd gear; 21-3rd needle bearing; 22-3rd gear; 23-High speed synchronizer hub set; 24-Input shaft bearing; 25-Input shaft; 26-C ring; 27-Front bearing; 28-Counter shaft; 29-Centre bearing; 30-Reverse gear; 31-Counter shaft 5th gear; 32-Pin ; 33-Washer ; 34-Reverse idle gear; 35-Reverse gear shaft; 36-Speedometer drive gear; 37-Circlip; 38-Ring; 39-Ring spring; 40-Front bearing；41-Ring bearing;42-oil seal；43-main shaft

● Transmission Drive Way (FIG.10-2)

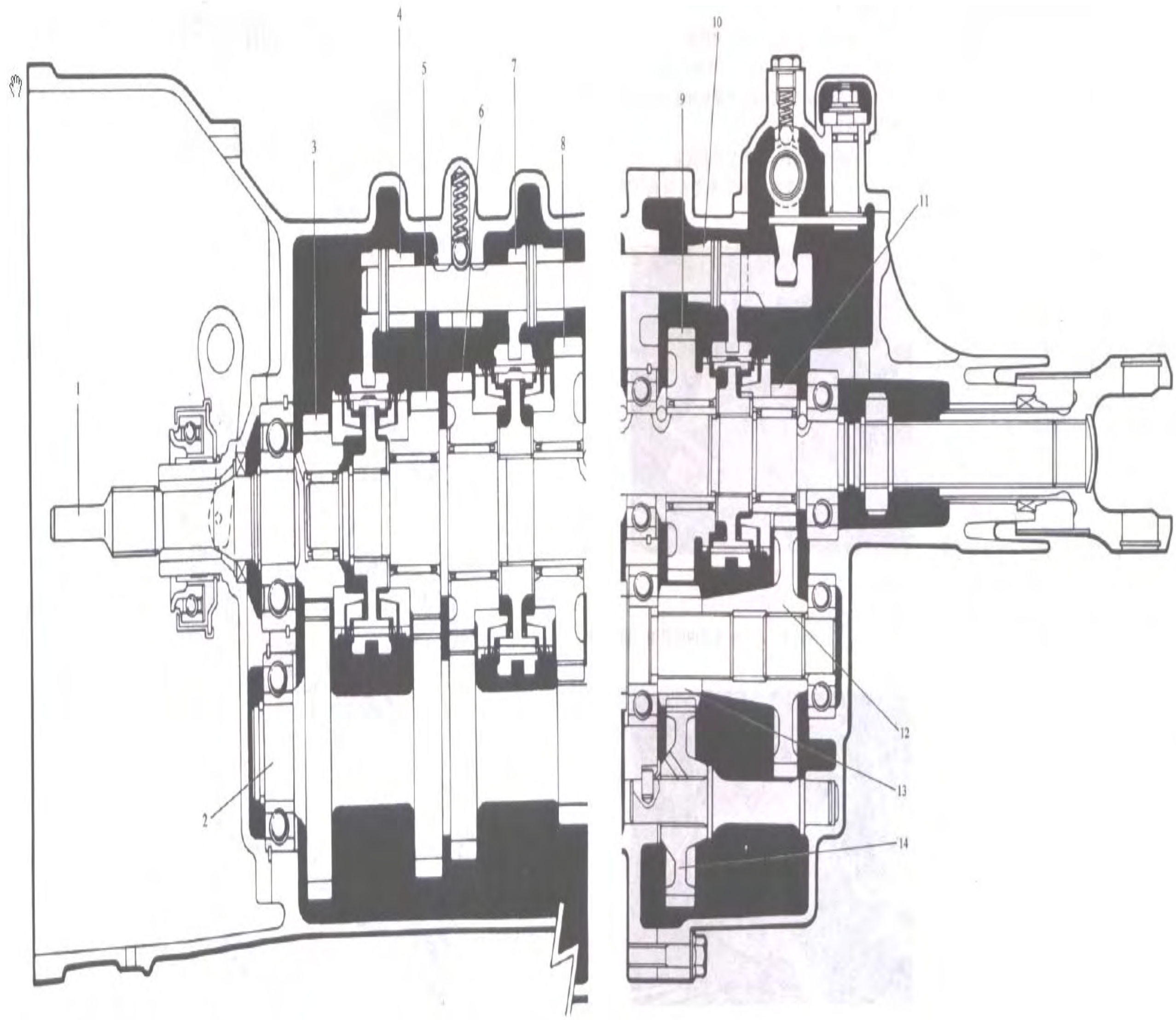


Fig 10-2

1-Input shaft ；2-Counter shaft ；3-Reduction drive gear；4-High speed gear shift fork；5-3rd gear；6-2nd gear；7-Low speed gear shift fork；8-Low gear；9-Reverse gear；10-Reverse gear shift fork；11-5th gear；12-Counter shaft 5th gear； 14-Reverse idle gear

Low gear, 2rd gear, 3rd gear：The power is inputted from input shaft，transfer to counter shaft gear from input shaft drive gear. Power then transfer to low speed driven gear, 2rd driven gear and 3rd driven gear from low speed drive gear, 2rd drive gear and 3rd drive gear of counter shaft. When shifting gear，shift fork push outer ring with synchronizer key and synchronizer ring to move to driven gear. Then inner cone of synchronizer ring contact with outer cone of driven gear, and inner spline of outer ring mesh with outer spline of driven gear. The engine power transfer from driven gear, outer ring and sleeve to output.Synchronizing ring can make the rotation speed of drive and driven section consistent to decrease gear shift impact.

When shifting to 4^{rd} gear(direct gear)，input shaft connect output shaft together through out ring sleeve. The engine power transfer from input shaft to output shaft directly.

When shifting to 5^{rd} gear(over drive gear), the engine power transfer from input shaft constant mesh gear, 5^{rd} drive gear of counter shaft and 5^{rd} driven gear of output shaft to output shaft.

When shifting to reverse gear，the engine power transfer from input shaft, counter shaft to reverse gear drive gear of counter shaft. Now, the rotation direction of output shaft and input shaft is reverse. When shifting to reverse gear，gear shift fork push outer ring to move to reverse gear drive gear. Because reverse gear rotate speed is low, out ring inner spline can mesh with reverse gear driven gear out spline without synchronizing ring to complete reverse gear operation.

Transmission interlock device can ensure only one gear being at work at the same time.

● Transmission Gear Ratio

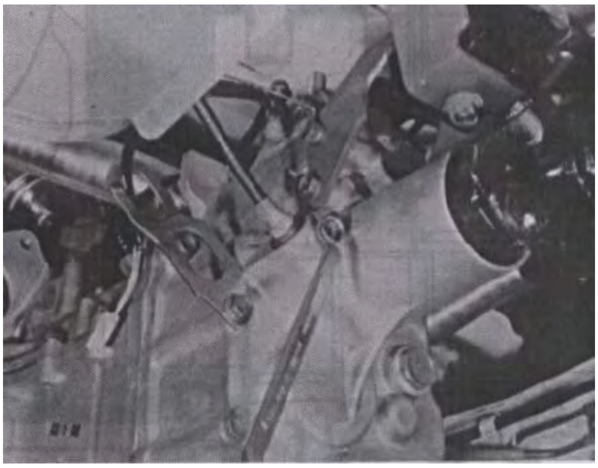
TABLE 10-1

Primary gear ratio		35/23				--	35/23
Primary speed ratio		1.521				--	1.521
Shift position		Reverse	Low	Second	Third	Fourth	Fifth*
Secondary ratios	Gear ratio	41/18	36/15	32/25	29/31	-	23/44
	Speed ratio	2.277	2.400	1.280	0.935	-	0.522
Overall speed reduction ratio		3.466	3.652	1.947	1.423	1.000	0.795

* Is optional.

● Disassembly

(1) Disconnect negative (-) and positive (+) cords from battery terminals and jack up the vehicle.
(2) Disconnect back light switch lead wire at coupler.
(3) Disconnect black/Yellow lead wire and positive (+) cord from starter motor.
(4) Remove starter motor from transmission case and disconnect battery negative (-) cord from transmission case.
(5) Free back light switch lead wire from clamps.
(6) Disconnect speed meter cable from transmission case. (FIG.10-3)
(7) Remove drain plug to drain oil in transmission. (FIG.10-4)



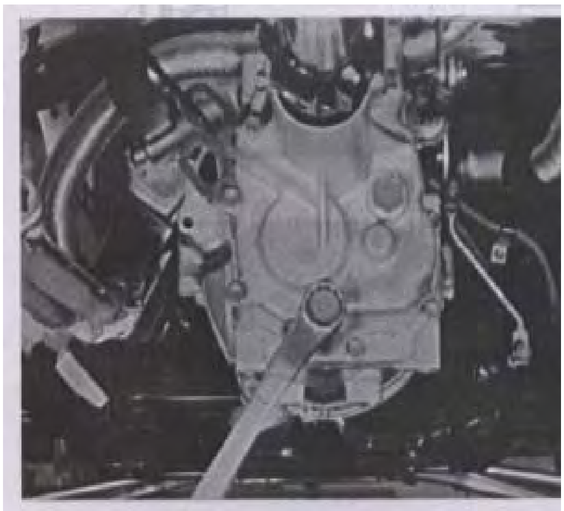


Fig 10-4

Fig10-3

(8) Disconnect clutch wire from clutch release lever.
(9) Disconnect gear shift cable and select cable from each lever and bracket. (FIG.10-5)
(10) Remove propeller shaft and disconnect warm air hose clamp from bracket on transmission case.
(11) Remove clutch housing lower plate from transmission case. (FIG.10-6)

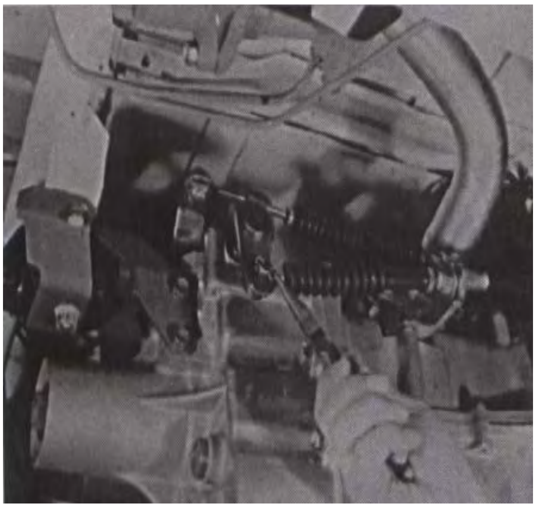


Fig 10-5

Fig. 10-6

(12) Remove bolts fastening engine cylinder block and transmission case.

CAUTION
Before starting to remove transmission, check around once again to be sure that there is no connection left undone.

(13) Remove transmission rear mounting bracket from chassis.
(14) Take down transmission.

● Disassembly

1) Replacing Clutch Release Shaft Bush
(1) Remove clutch release bearing from input shaft bearing retainer (FIG.10-7)
(2) Remove a part of spring from clutch release shaft lever. (FIG.10-8)

(3) Remove clutch release lever from shaft. With clutch release bush remover(A)(special tool)applied in such a position as shown in FIG.10-9, tap its end to take out bush. If bush can not be taken out of transmission case in the above manner, grip bush with pliers or the like and pull out.
(4) Remove clutch release shaft from transmission case. (FIG.10-10)

Fig 10-7

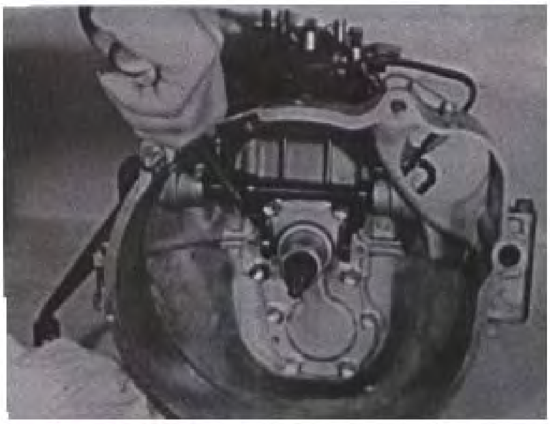


Fig10-8

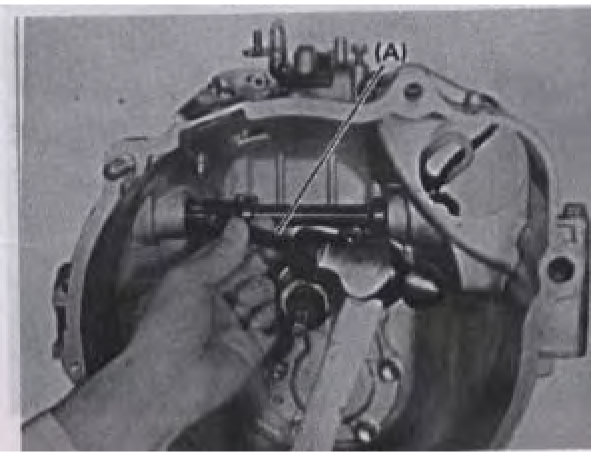


Fig 10-9

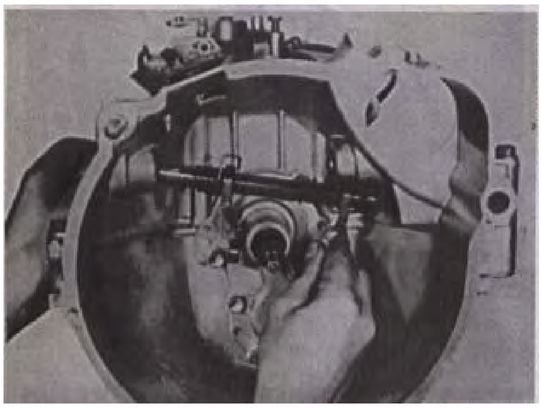


Fig 10-10

2) Precautions on bush reinstallation:
(1) Make sure to apply grease to inside of bushes.
(2) Drive in bushes to the same level as outside surface of transmission case.(FIG.10-11)
(3) After installing bush, caulk transmission case against bush at 2 points. (FIG.10-12)

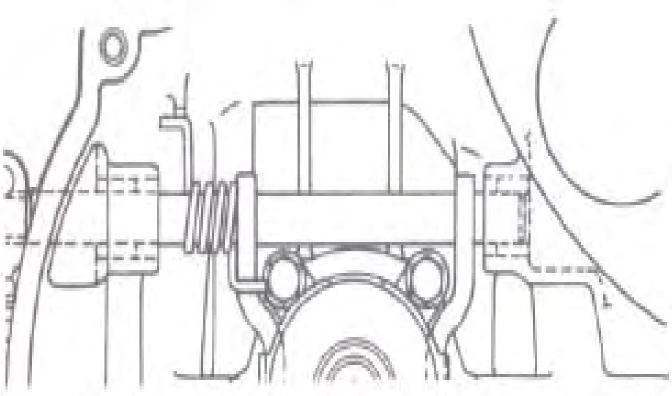


Fig 10-11

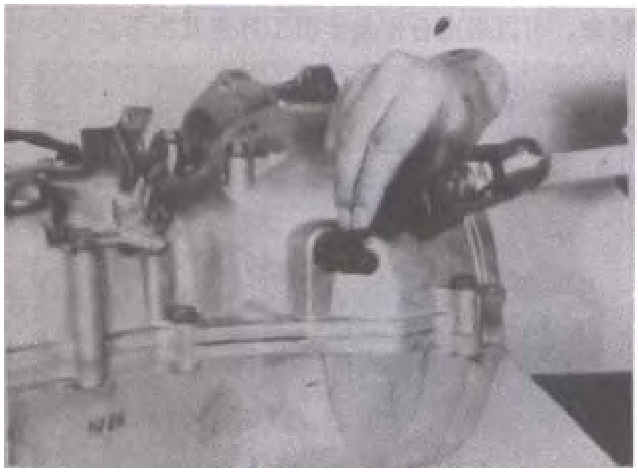


Fig 10-12

3) Separating Upper Case from Lower Case

(1) Remove clutch release bearing from transmission input shaft. (FIG.10-13)

(2) Remove input shaft bearing retainer bolts and pull out retainer (FIG.10-14)

(3) Remove gear shift lever case and speed meter driven gear case.

(4) Remove bolts securing extension case to transmission case and take off extension case. (FIG.10-15)

(5) Remove bolts fastening upper and lower cases together, separate cases, and take out main shaft assembly. A steel bar, similar in shape to screwdriver, may have to be sued to pry cases apart. In dong so, do not stick bar too far into between two mating faces, or faces may become damaged. (FIG.10-16, FIG.10-17, FIG.10-18)

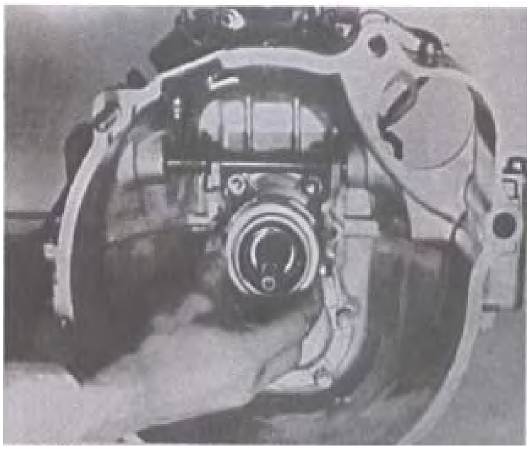


Fig 10-13

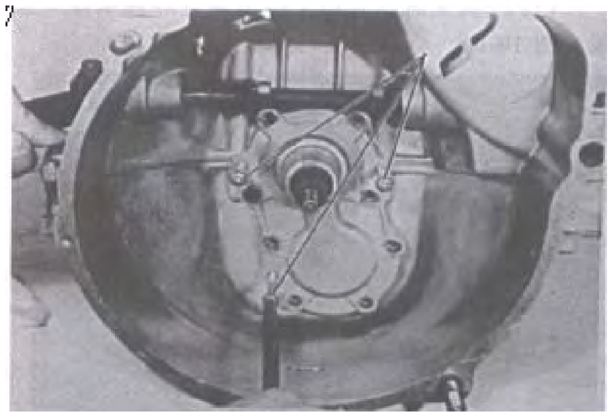


Fig 10-14

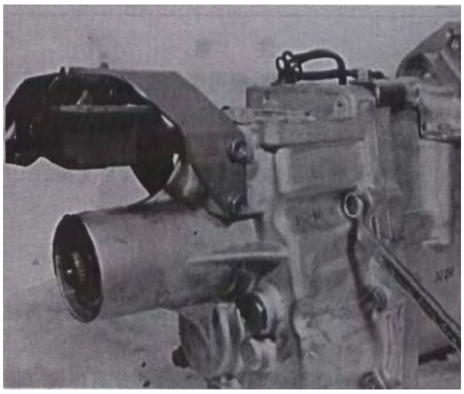


Fig　10-15

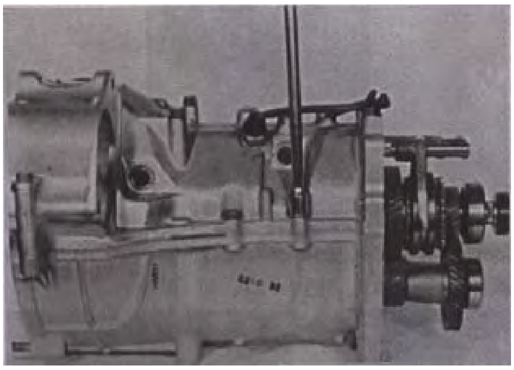


Fig10-16

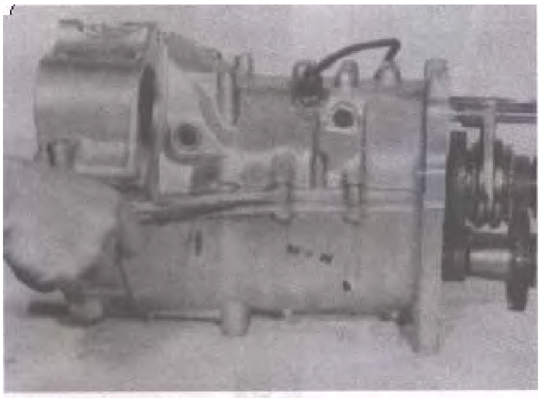


Fig　10-17

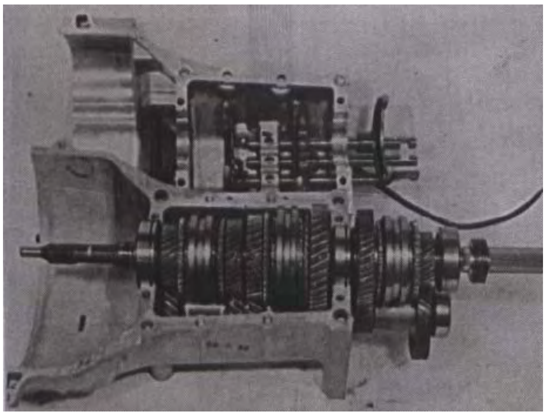


Fig　10-18

4) Removing Countershaft

(1) Remove reverse gear shaft with gear. (FIG.10-19)

(2) Remove countershaft rear bearing. Bearing puller (B)(special tool)(FIG.10-20)

(3) Remove countershaft 5^{th} gear and counter-shaft reverse gear. (FIG.10-21)

(4) Remove circlip from countershaft by using bearing remover (B). Push out countershaft to extension case side by using hydraulic press, remove bearing, and take countershaft assembly out of case. (FIG.10-22, FIG.10-23)

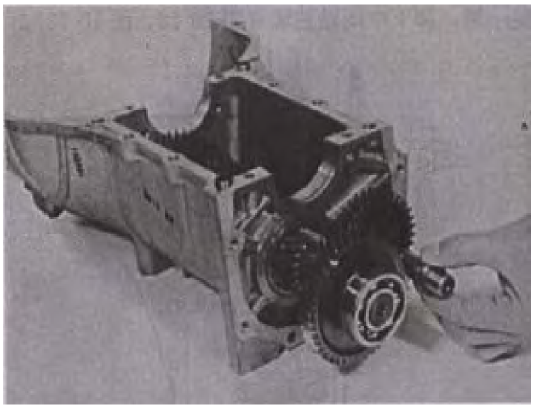


Fig　10-19

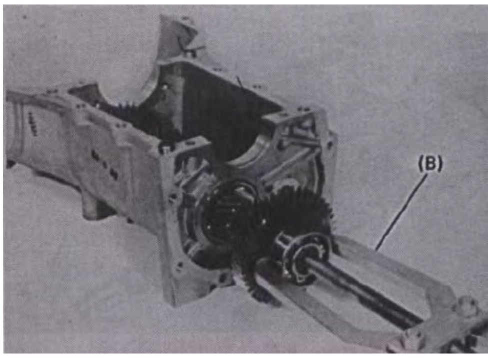


Fig　10-20

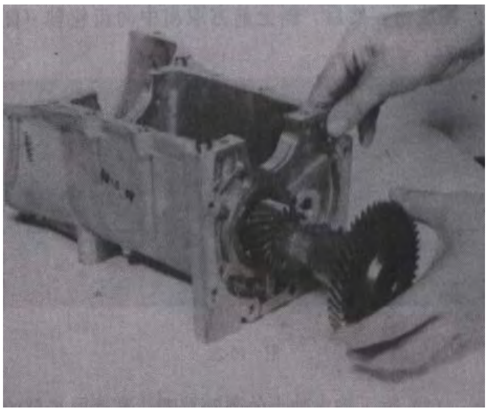


Fig10-21

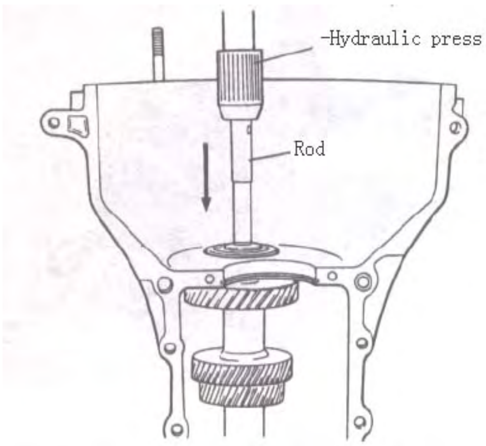


Fig　10-22

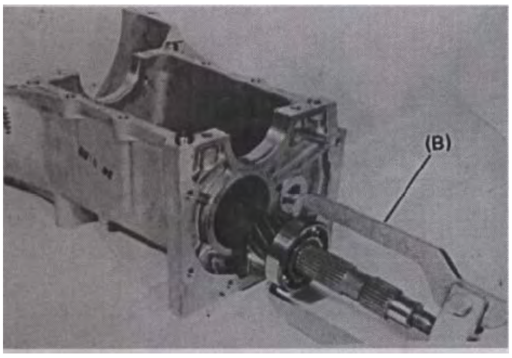


Fig　10-23

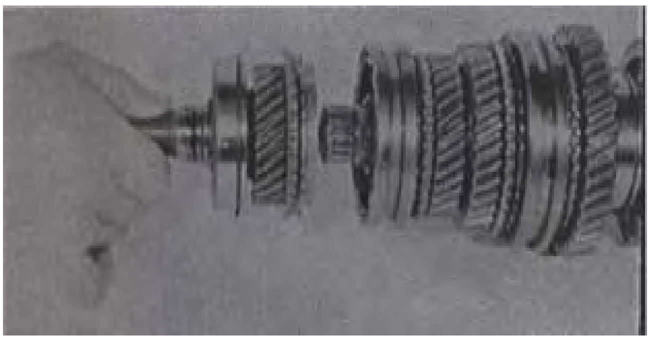


Fig　10-24

5）Remove Main Shaft and Input Shaft

（1）Take out input shaft by hand, taking care not to let high-speed synchronizer ring fall off .(FIG.10-24)

（2）Remove circlip retaining hub of high-speed synchronizer sleeve, and slide off sleeve hub, third driven gear and needle bearing from main shaft..（FIG.10-25）

（3）Remove circlip retaining speed meter drive gear(FIG.10-26), and slide off speed meter drive gear. Remove circlip retaining rear bearing on main shaft. Remove main shaft bearing.（FIG.10-27, FIG.10-28）

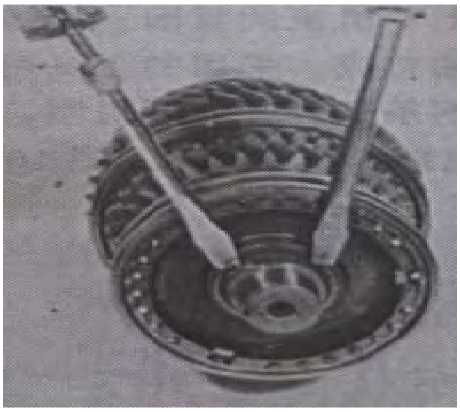


Fig　10-25

Fig　10-26

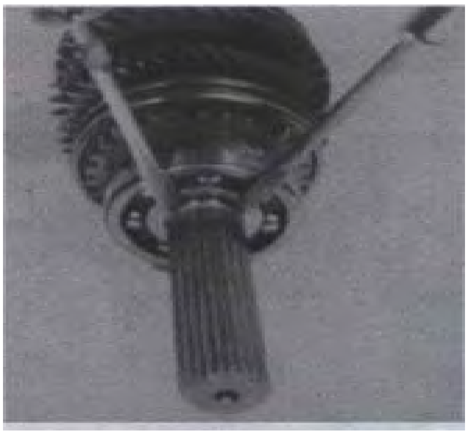


Fig　10-27

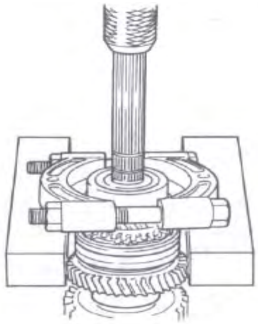


Fig　10-28

（4）from main shaft, take off 5th gear washer, ball, 5th gear, 5th speed synchronizer ring and 5th gear needle bearing.(FIG.10-29)

（5）Remove circlip retaining reverse synchronizer hub on main shaft.（FIG.10-30）

（6）Remove reverse synchronizer hub, reverse gear and reverse gear needle bearing.（FIG.10-30）

（7）Remove bearing washer and reverse gear bush on main shaft by using hydraulic press.(FIG.10-32）

> CAUTION
>
> During this removal, watch out for a ball which may fall off. It must not be lost. Also, ball bearing should not be removed together with above washer and

（8）remove ball and main shaft bearing by suing hydraulic press.（FIG.10-33）

> CAUTION
>
> In the state as shown in FIG.10-33, be sure to prevent ball in bearing from falling off and getting lost.

（9）remove low gear, needle bearing and synchronizer ring on main shaft.（FIG.10-34）

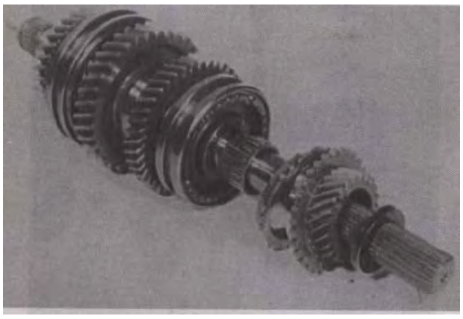


Fig 10-29

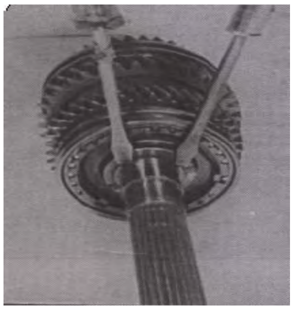


Fig 10-30

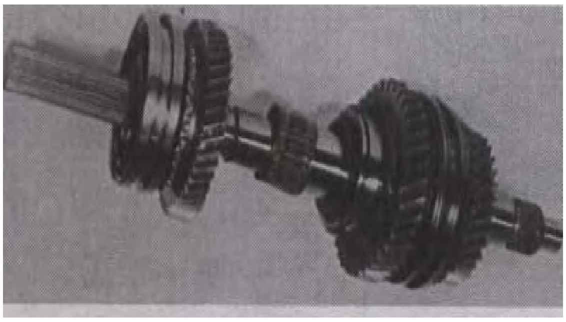


Fig 10-31

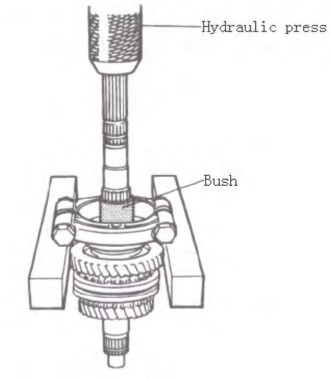


Fig 10-32

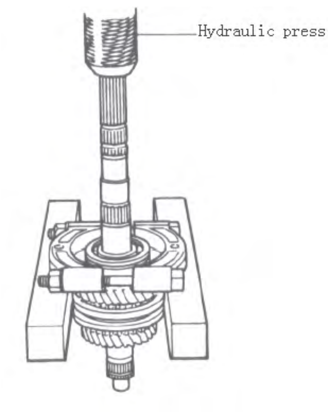


Fig10-33

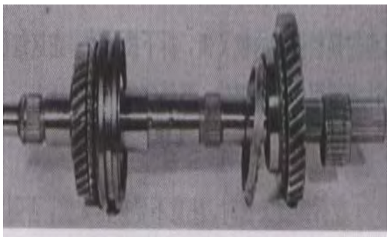


Fig 10-34

（10）Remove low gear bush, low speed synchronizer hub, ring, 2nd gear and 2nd gear bearing by suing

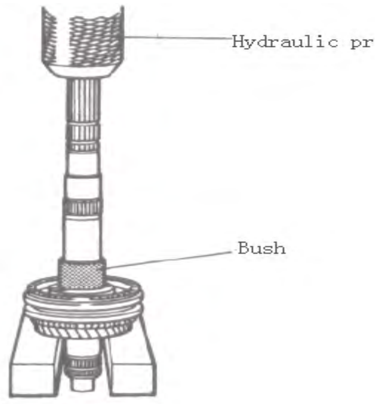


Fig　10-35

hydraulic press.（FIG.10-35）

6）Removing Shift Forks and Shafts（FIG.10-36）

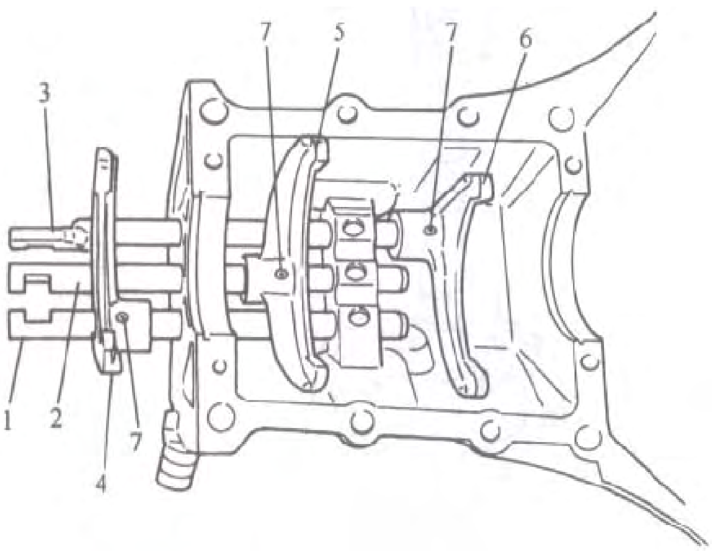


Fig　10-36

Fig　10-36:1.Reverse shift shaft;2-Low speed gear shift shaft;3-High speed gear shift shaft ;4-Reverse gear shift fork;5-Low speed shift fork;6-High speed gear shift fork;7-Shift yoke pin

Before starting removal, make sure that all shift fork shafts in place are in neutral position and remove each fork and shaft according to following steps（1），（2），（3）.(FIG.10-37)

（1）Pull out reverse gear shift shaft. As this shaft comes out, locating ball and spring will jump out of hole; do not let them fly away.（FIG.10-38）

（2）Using spring pin remover (C) (special tool), drive out yoke pin on low speed gear shift fork, and pullout shift shaft. During this work, be careful not to let locating ball, interlock ball and spring fly away.

CAUTION

When removing yoke pin, be sure not to drive it out so far as to contact case. Or it will cause damage to case.（FIG.10-39,FIG.10-40）

（3）Drive yoke pin out of high speed gear shift fork as in above step (2) and pull out fork shaft and fork.

（FIG.10-41 and FIG.10-42）

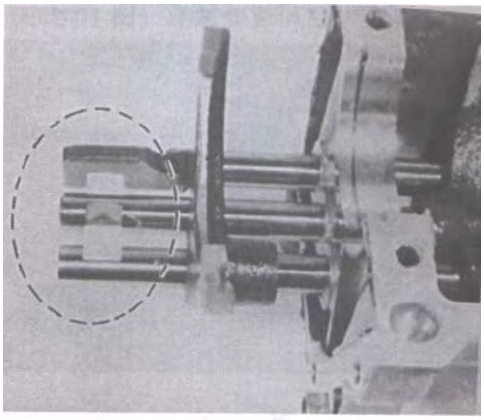


Fig　10-37

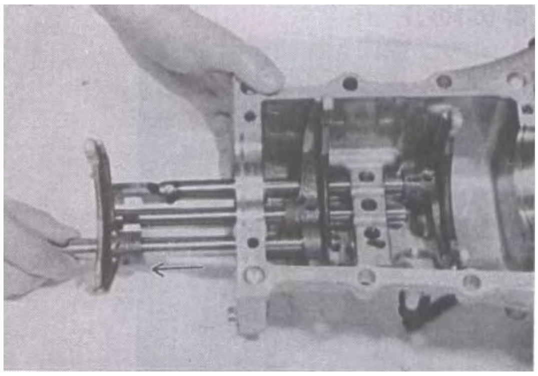


Fig　10-38

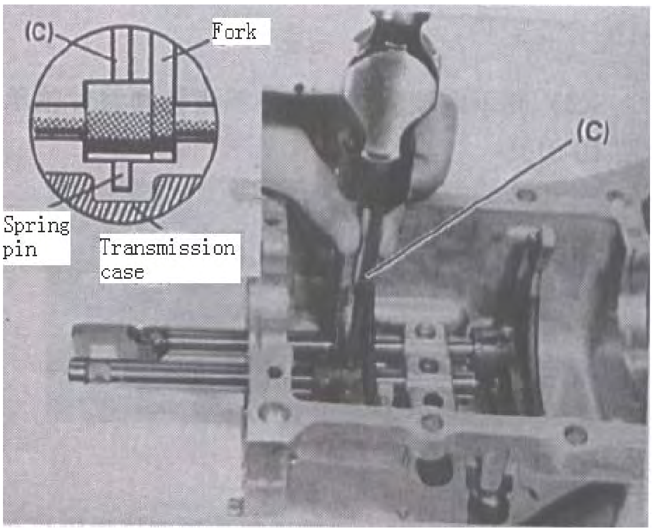


Fig　10-39

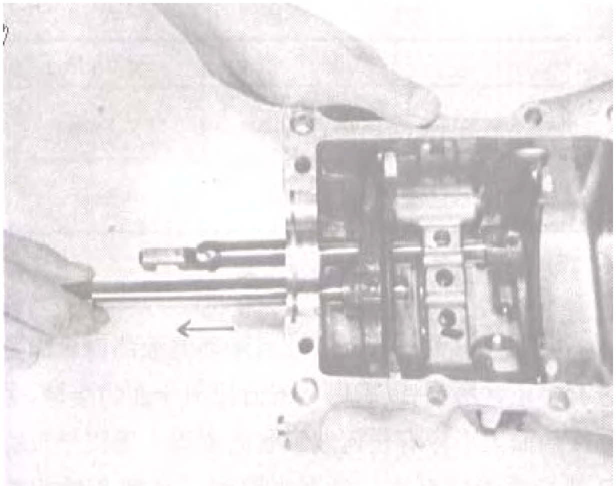


Fig　10-40

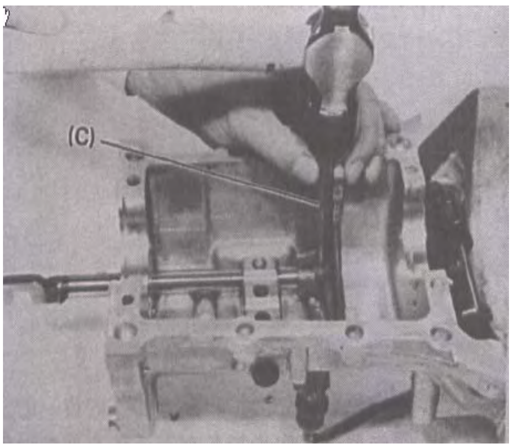


Fig　10-41

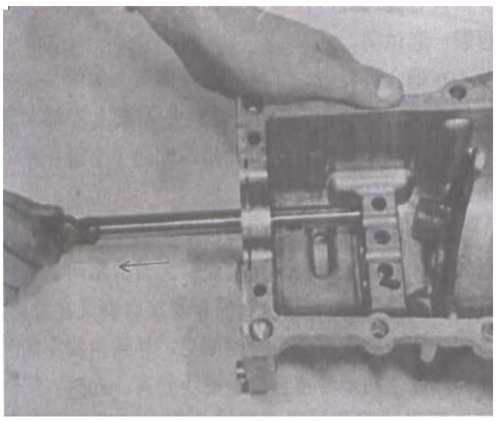


Fig　10-42

- INSPECTION OF COMPONENTS

1）Gears

Check each part for wear, damage or discoloration. Replace if found defective(FIG 10-43)

2）Synchronizer Hubs, Sleeves and Keys

Check each part for wear of damage. Replace if found defective.（FIG.10-44）

3）Shift Forks and Sleeves

Check contact surfaces for wear or damage. Measure clearance between fork and sleeve.(FIG.10-45).The MAX. clearance should be 1.0mm.

4）Main Shaft

Check each part of shaft for wear, discoloration or damage. Replace shaft if any part is found defective.（FIG.10-46）

5）Bearing and Bushes

Check each part for wear, damage or discoloration. With ball bearing, check to ensure that it rotate smoothly and it does not make noise. Replace if found defective.（FIG.10-47）

6）Input Shaft

Referring to FIG.10-48, inspect cone ① and toothed ring ② for wear and damage. Inspect gear teeth③ and splines ④ for wear and damage. If any part of input shaft inspected as above is found excessively worn or badly damaged, replace shaft.

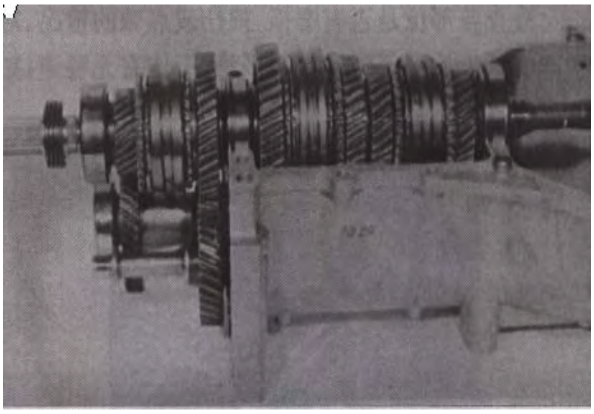


Fig　10-43

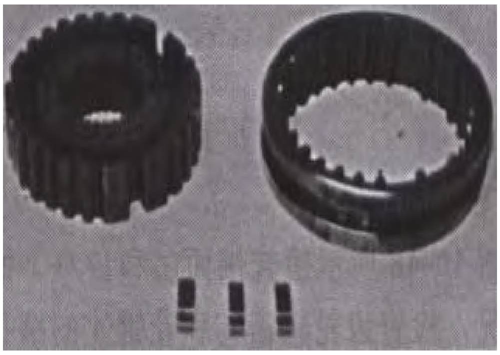


Fig　10-44

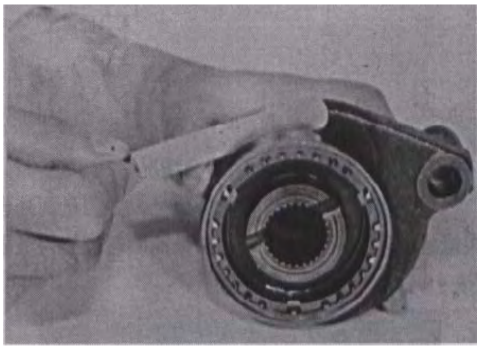


Fig　10-45

Fig 10-46

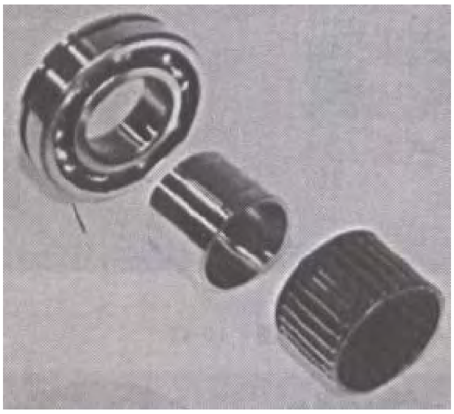


Fig　10-47

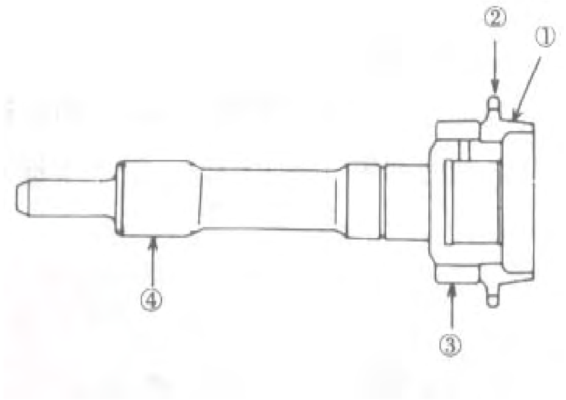


Fig　10-48

7）Combination of Gear and Synchronizer Ring

Fit ring to cone of each gear, and measure clearance between the two at peripheral teeth, as shown in FIG. 10-49. If clearance exceeds service limit, as shown is TABLE 10-2,　replacement is necessary.

Clearance between gear and ring

TABLE 10-2

	Standard	Service limit
Low and High speed	1.0～1.4mm	0.5mm
5th speed*	1.2～1.6mm	0.5mm

* is optional .

Inspect external cone of gear and internal cone or ring for abnormal wear. Be sure that contact patterns on these surfaces indicate uniform full-face contact, and that surfaces are free from any wavy wear. A badly worn member must be replaced. Proper synchronizing action on gear shifting can be expected only when ring-to-gear clearance（FIG.10-50）and condition of cone surfaces, among other things, are satisfactory.

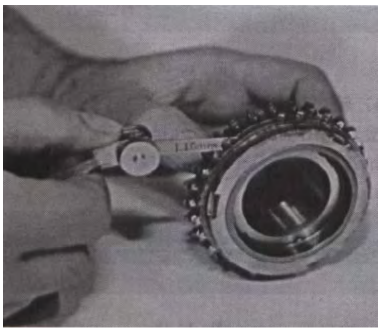


Fig　10-49

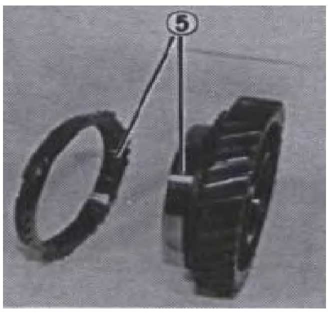


Fig　10-50

Chamfered Tooth Ends of Ring（External Teeth）and Sleeve（Internal Teeth）

Synchronizer ring and hub have 3 slots each, in which keys are carried as backed by expanding springs, so that hub and its 2 rings, one on each end, are capable of running together. Since sleeves engaged by its internal teeth with hub as if they were splined together, sleeve, too, runs with hub and rings.

In meshing action, sleeve is pushed (by shifter fork) to one side, so that if slides axially on the hub, pushing the ring toward the cone surface of the gear. This push is transmitted by 3 keys, which are lightly gripped by the sleeve.

By friction between gear cone and ring cone (internal), ring begins to rotate but is opposed by the hub because of keys. In other words, ring is at this time twisted, while sleeve is advancing further to push ring fully against gear cone. Since ring is unable to slide along any further, sleeve lets go off keys and rides over to ring. At this moment, initial contact between chamfered ends of teeth of ring and those of internal teeth of sleeve occurs. This contact is such that internal teeth of sleeve align themselves to those of the ring. When sleeve advances and slides into ring, ring will be rotating nearly and slides into ring, ring will be rotating nearly with the speed of gear, so that sleeve is enabled smoothly to slide over into clutch teeth of gear.

The initial contactor mesh between sleeve and ring is determined by widths of key and slot or, in other words, key clearance in the slot, and is prescribed to extend at least a third (1/3) of chamfer.

With synchronizer properly assembled on shaft, push in and twist each synchronizer to see if one-third mesh occurs; if not, it means that overall wear (which is the sum of wears of slots, keys and chamfered tooth ends) is excessive and, in such a case, synchronizer assembly must be replaced as a whole.（FIG.10-51）.

8）Synchronizer Rings

Inspect each synchronizer ring for wear of its key slots by measuring width of each slot. If width reading exceeds limit（TABLE 10-3）, replace ring.（FIG.10-52）

TABLE 10-3

Key slot width of synchronizer ring	Standard	Service limit
	10.1mm	10.4mm

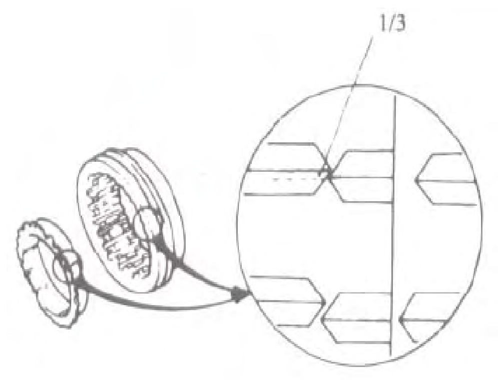


Fig 10-51

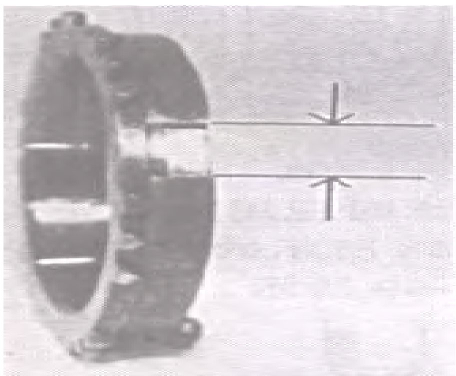


Fig 10-52

9）Fork shaft locating springs

If "gears slipping out of mesh" has been complained, check these springs for strength by measuring their free length, and replace them if their free length, and replace them if their free lengths are less than service limit.（TABLE 10-4, FIG.10-53）

TABLE 10-4

	Standard	Service limit
Free length	25.5mm	21.0mm

10）Gear Shift Shafts

Check the part of shaft as indicated in FIG.10-54 for uneven wear. Replace shaft if uneven wear is noted.

11）Extension Case Bush

Check bush press-fitted in extension case for wear by measuring radial clearance between bush bore and sliding yoke. If sliding yoke rattles in bush because of advanced wear it will cause propeller shaft to rattle. For this reason, an extension case found to allow its sliding yoke to rattle in excess of service limit （TABLE 10-5）must be replaced; replacement of bush alone is not permissible.

TABLE 10-5

Rattle of sliding yoke in extension case bush	Standard	Service limit
	0.025～0.089mm	0.2mm

- IMPORTANT STEPS IN INSTALLATION

CAUTION

① Before installation, wash each part and apply gear oil to sliding faces of bearing and gear;

② Use new circlips on shaft for reinstallation. Do not reuse used circlips；

③ Tighten each fastening bolt and nut according to specified torque data listed on the last page of this section.

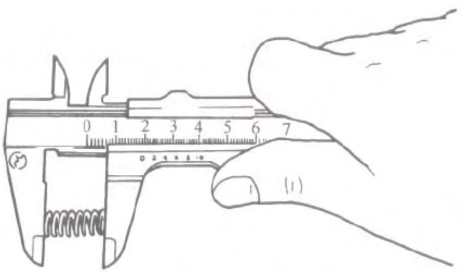


Fig 10-53

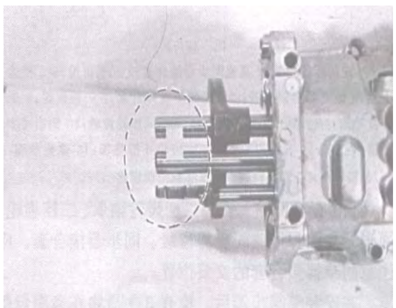


Fig 10-54

1）Main Shaft and Input Shaft

Install each part in reverse order of removal procedure. Be careful for installing direction of each washer, gear, synchronizer hub and sleeve. Refer to FIG. 10-55. Make sure to install each ball on main shaft.

（1）Install 2nd gear bearing. 2nd gear, synchronizer ring and low speed synchronizer hub/sleeve onto main shaft, using care for installing direction of synchronizer sleeve.

After putting on each synchronizer, be sure that 3 keys mounted on hub fit snugly into slots cut in ring.（FIG.10-56）

Then using hydraulic press (D) (special tool), press-fit low gear bush.（FIG.10-57）

（2）install low gear needle bearing, synchronizer ring spring, synchronizer ring, low gear, ball and washer onto main shaft. Fit ball into hole in shaft and install washer so that ins slot ① comes over ball ③.

To direct washer correctly, bring its circumpherence chamfered side ② to main shaft centre bearing.（FIG.10-58）

（3）press-fit centre bearing with bearing installer (D)（special tool），using care for its installing direction. (FIG.10-59)

（4）Install ball and washer.

As shown in FIG.10-60，install washer so that its circumference chamfered side faces centre bearing ① and its slot ② comes over ball ③.

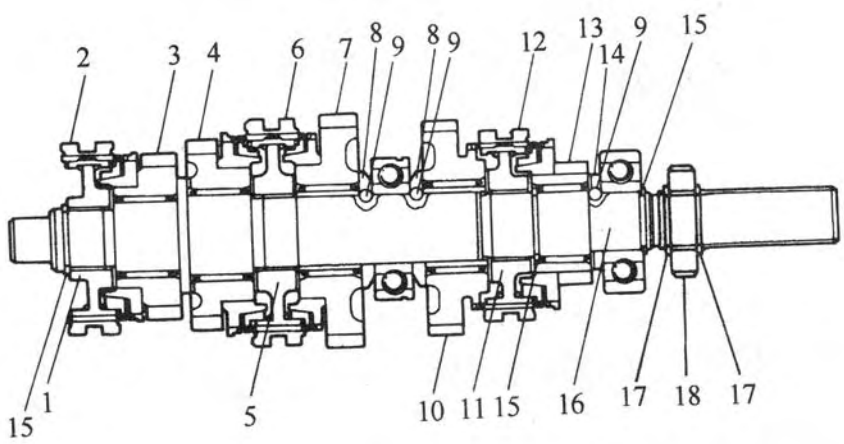


Fig 10-55

. 1. High speed synchronizer hub 2.High speed synchronizer sleeve 3. 3^{nd} gear 4. 2^{nd} gear 5.Low speed synchronizer hub 6. Low speed synchronizer sleeve 7.Low gear 8. Washer 9. Ball

10 Reverse gear 11 Reverse synchronizer hub 12.Reverse synchronizer sleeve13 5^{th} gear 14 5^{th} gear washer

15 Clip 16 Main shaft 17 Circlip 18 Speed meter drive gear

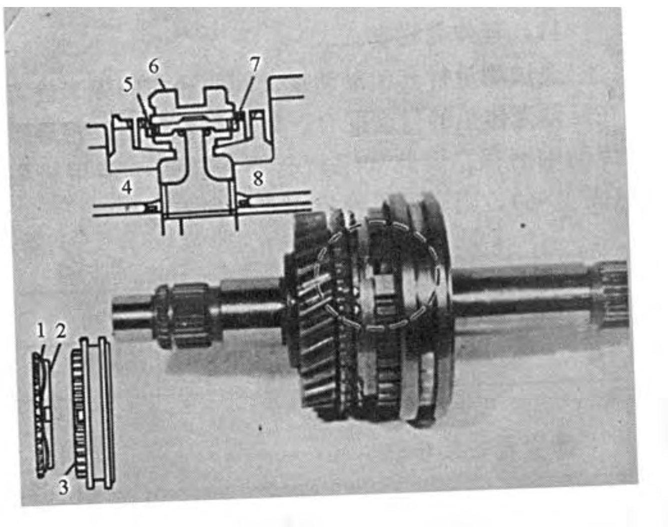


Fig 10-56

1. Ring spring 2. Ring 3. Synchronizer hub 4. 2^{nd} gear 5. Synchronizer ring spring 6. Synchronizer sleeve 7. Synchronizer ring spring 8. Low gear

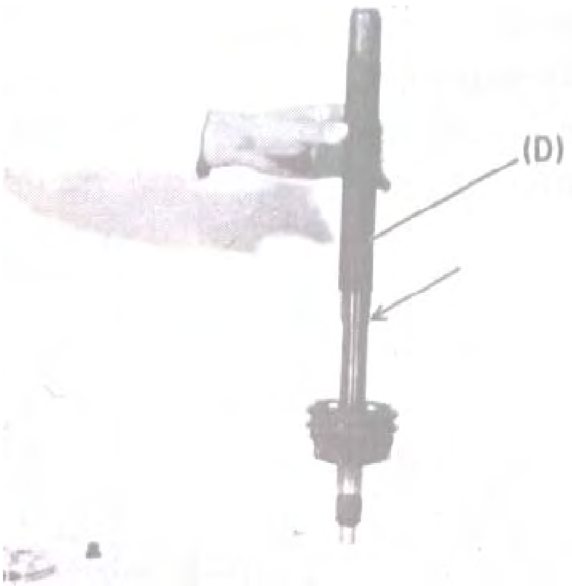


Fig　10-57

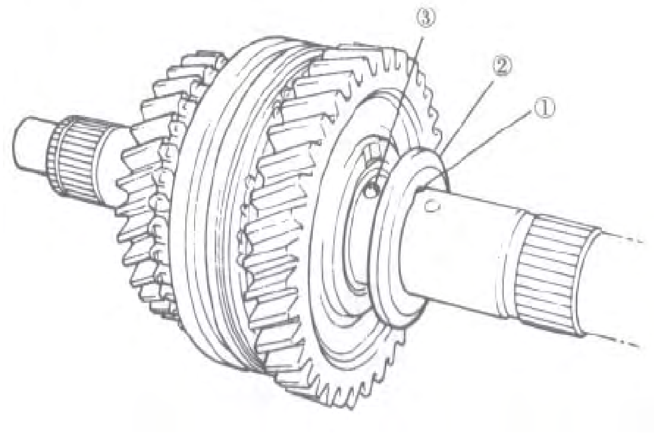


Fig　10-58

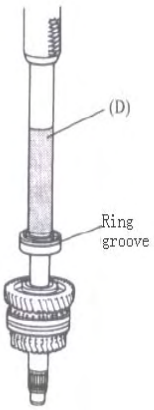


Fig　10-59

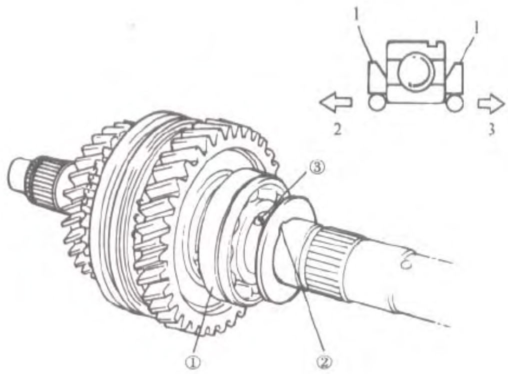


Fig　10-60

1- Washer； 2-Input shaft side； 3-Rear bearing side

（5）Press-fit reverse gear bush, preventing ball installed in step（4） from coming off. Bearing installer (D) is shown in FIG. 10-61.

（6）Install reverse gear bearing, reverse gear and reverse synchronizer hub/sleeve . for proper direction, make sure to install hub so that the side whose inside boss ① is smaller in diameter and longer is directed to main shaft rear bearing, and sleeve so that the side whose inside is stepped ② is also directed to main shaft rear bearing.（FIG.10-62, FIG.10-63）

（7）Fit reverse hub circlip into groove in main shaft.（Fig　10-64）。

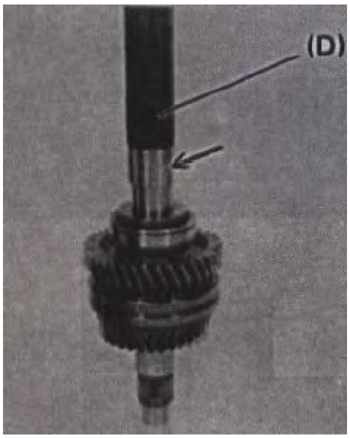


Fig　10-61

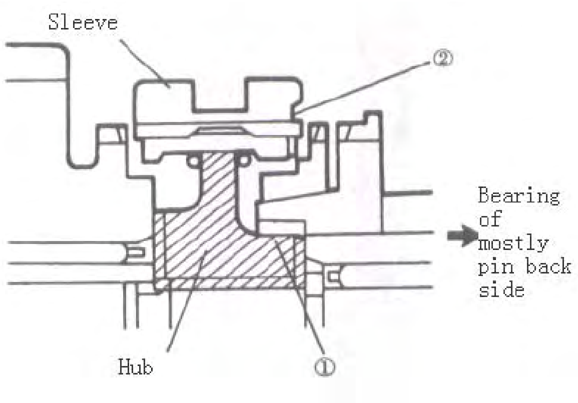


Fig　10-62

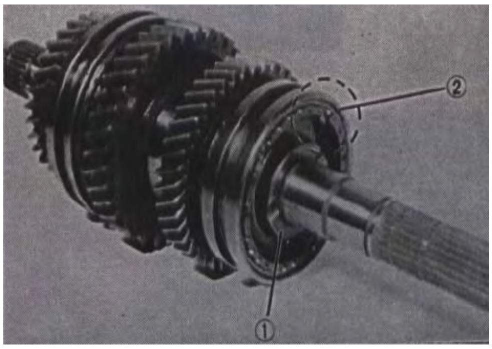


Fig　10-63

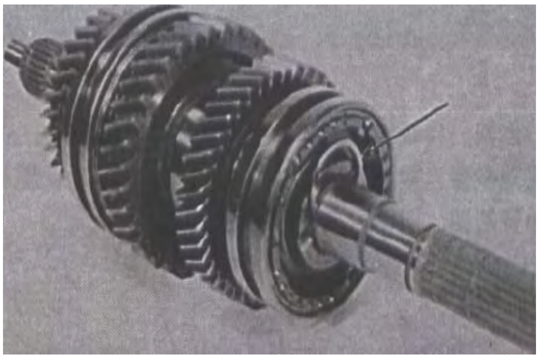


Fig　10-64

（8）Install 5th gear bearing, 5th gear synchronizer ring and 5th gear. Then install ball and waher, making oil groove of washer face 5th gear.（FIG.10-65）

（9）Press-fit main shaft rear bearing using bearing installer（D） and fit circlip into groove in main shaft .（FIG.10-66, FIG.10-67）

（10）Install 3rd gear bearing, 3rd gear, high speed synchronizer ring and hub/sleeve. When installing hub, direct the side with larger outer diameter boss to 3rd gear side. Then fit circlip into groove in main shaft.（FIG.10-68, FIG.10-69）

（11）Install speed meter drive gear on mainshaft.（FIG.10-70）

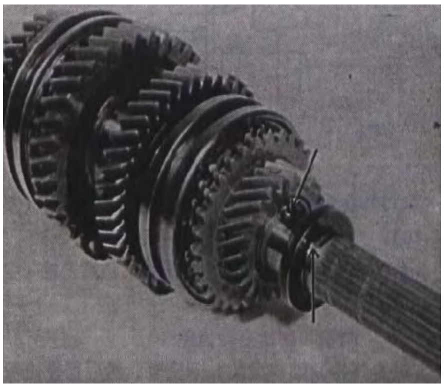


Fig　10-65

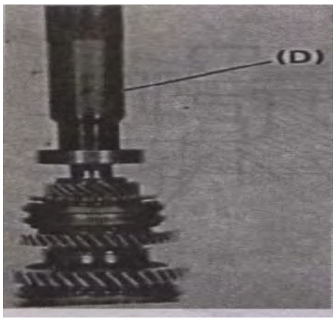


Fig　10-66

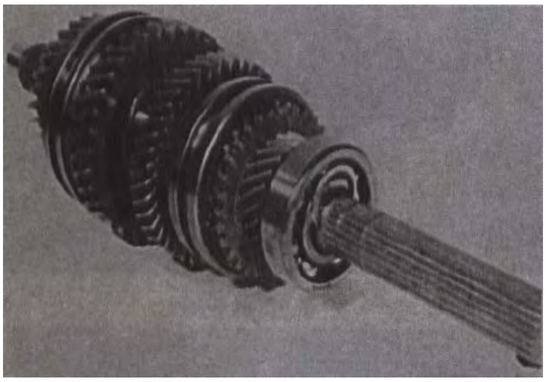


Fig　10-67

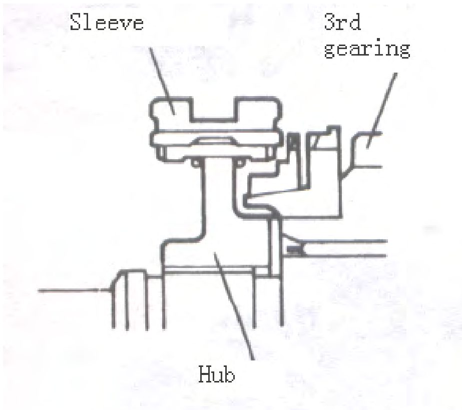


Fig　10-68

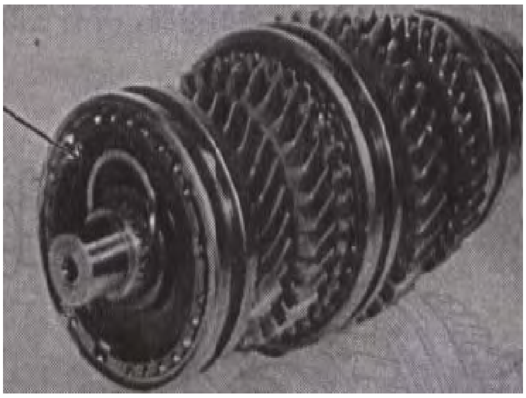


Fig　10-69

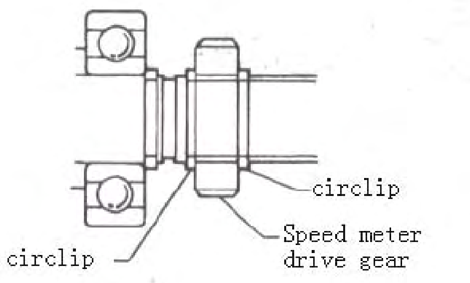


Fig　10-70

（12）Install synchronizer ring, needle bearing and input shaft.（FIG.10-71）

2）Counter Shaft and Reverse Idle Gear

（1）Drive counter shaft front bearing into lower case. Then using plastic hammer, drive counter shaft into front bearing a little. In the above state, using bearing installer (D) (special tool)，drive center bearing onto counter shaft and into lower case.（FIG.10-72）

（2）Fit counter shaft front circlip into groove in shaft.（FIG.10-73）

（3）Install counter shaft reverse gear and 5th gear onto counter shaft. And then drive counter shaft rear bearing onto it.（FIG.10-74）

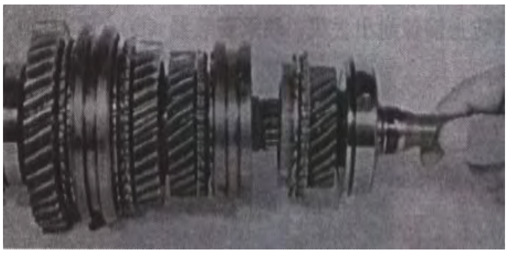


Fig　10-71

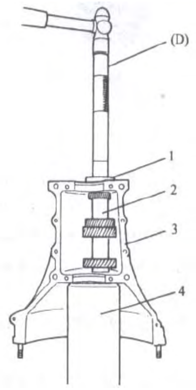


Fig　10-72

1-center bearing；2-counter shaft；3-transmission lower case；4-wood stand

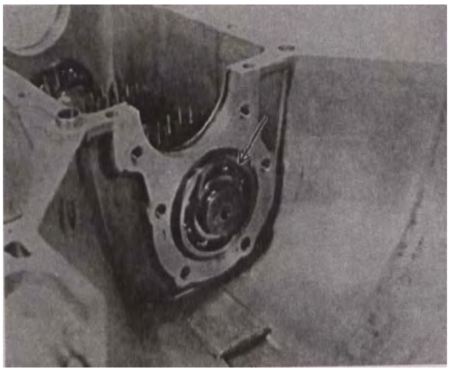


Fig　10-73

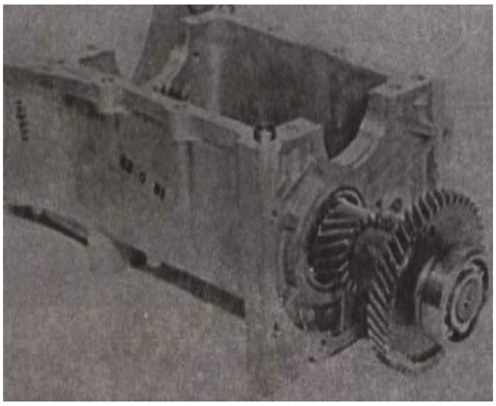


Fig　10-74

（4）install idle gear and washer onto reverse gear shaft and pin into it. Install above as assembledinto lower case with pin ① and washer tongue② aligned as shown in FIG. 10-75,10-76.

3）Shifter Forks, Shafts and Yokes（FIG.10-77、10-78）

CAUTION
High speed gear shift fork is distinguished from reverse gear shift fork by the part indicated as (A) in FIG.10-78 for being straight..

Note that 3 shift shafts individually have a locating ball as ①,③,⑥ and locating spring, and that 2 interlock balls as ②,⑤ and an interlock roller as ④ are used between shafts as shown in FIG..10-79.

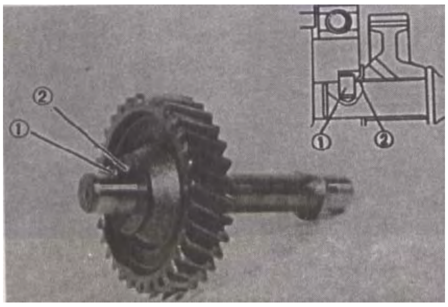


Fig 10-75

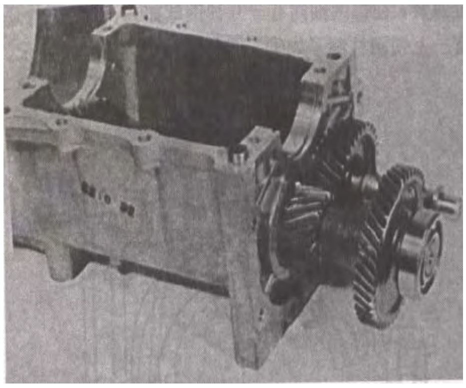


Fig 10-76

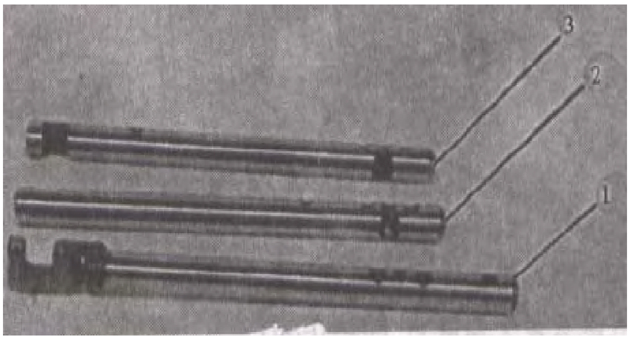


Fig 10-77

1- High speed gear shaft; 2-Low speed gear shaft; 3-Reverse gear shift shaft

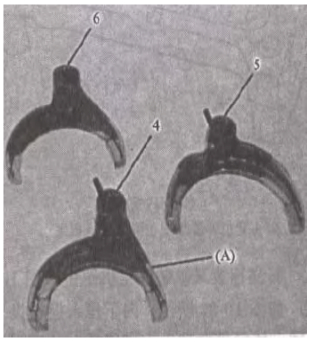


Fig 10-78

4-High speed gear shift fork

5-Low speed gear shift fork

6-Reverse gear shift fork

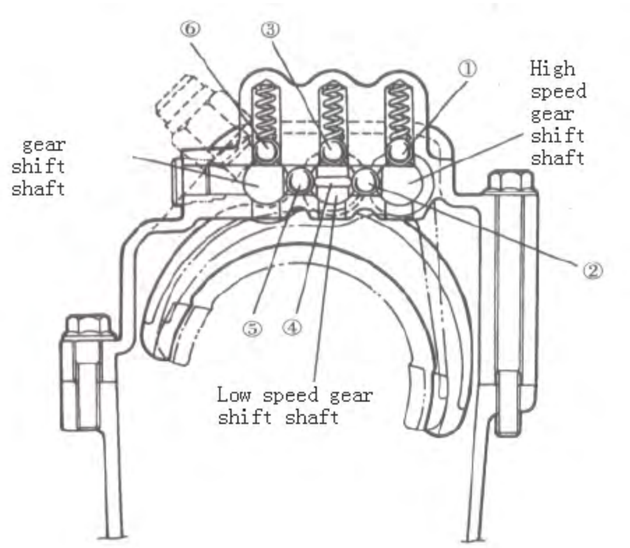


Fig 10-79

4) Install High, Low and Reverse Shafts in That Order.

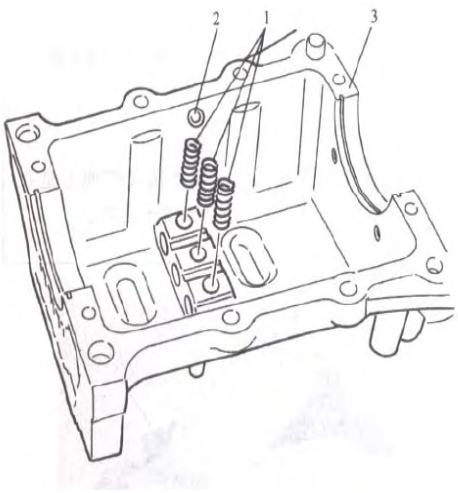


Fig 10-80

1、 Locating spring ；2－Locating ball；3－Upper case

（1）install 3 locating spring into 3 holes in upper case. Fit locating ball on top of locating spring in hole.（FIG.10-80）

（2）Insert high speed gear shift shaft into upper case.（FIG.10-81）

（3）As shown in FIG.10-82，push down high speed gear shift shaft locating ball to pass shaft over it and keep inserting shaft until locating ball fits in center slot of 3 continuous slots in shaft. Drive shift yoke pin into fork and shaft.

（4）Install interlock ball(2 in FIG.10-79) and locating ball(3 In FIG.10-79) in upper case. After installing interlock roller in low speed gear shift shaft and insert shaft into upper case as described in （2）（3）. Fork should be installed in such direction as shown in FIG. 10-83. Then drive shift yoke pin until it becomes flush with outer surface of fork.

（5）Install interlock ball（5 in FIG.10-79）and locating ball（6 in FIG. 10-79）into upper case. Then insert reverse gear shift shaft into upper case as described in （2），（3）（FIG.10-84）

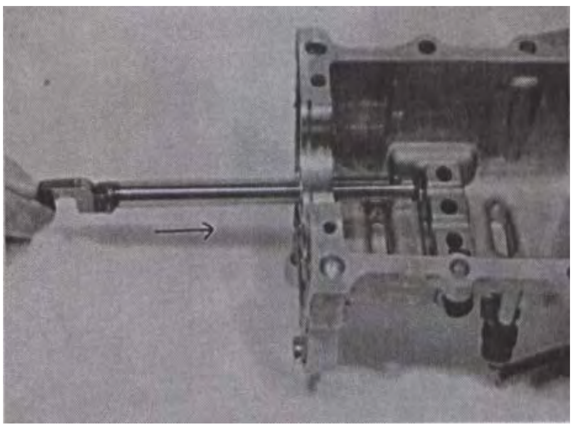


Fig 10-81

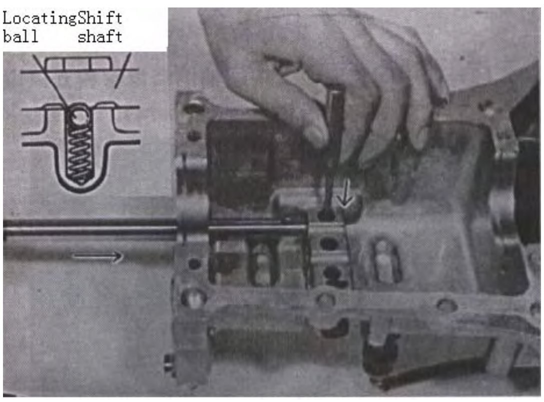


Fig 10-82

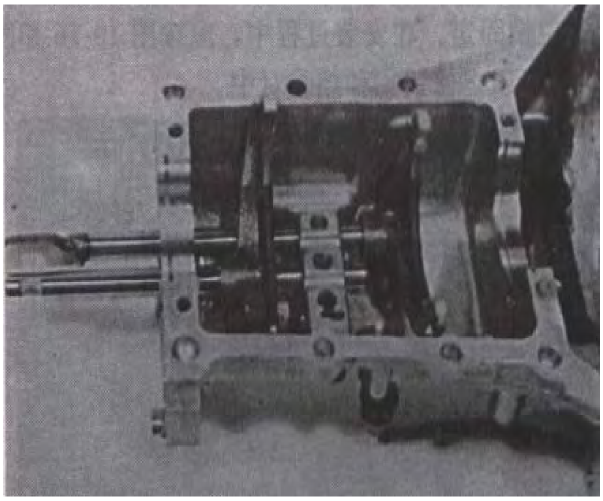


Fig 10-83

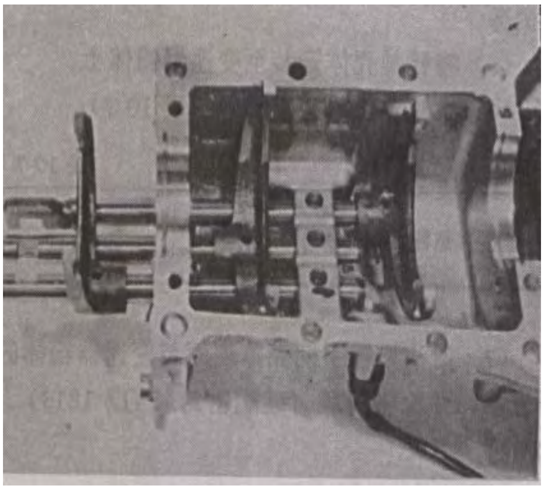


Fig 10-84

5）Transmission Lower Case And Upper Case

（1）With counter shaft ass’y, reverse idle gear and reverse gear shaft installed in lower case, check to ensure that 2 knock pins ① are fitted in both sides of lower case as shown in FIG. 10-85.

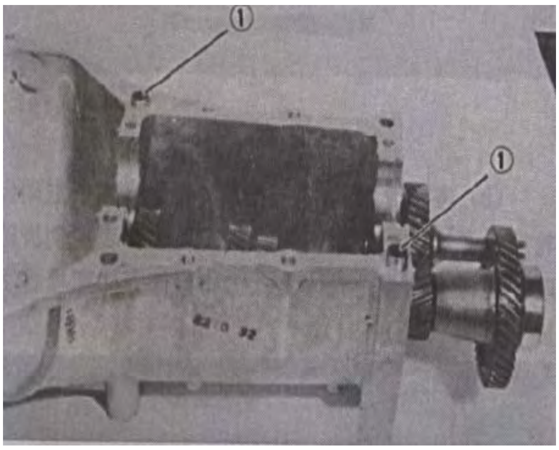
（2）Make sure that mating surfaces of both lower and upper cases are clean.

（3）Check to make sure that bearing stopper ring ① are fitted in grooves of front bearing and center bearing which are on main shaft.（FIG.10-86）

（4）Install main shaft and input shaft ass’y in lower case.（FIG.10-87、10-88）

（5）Uniformly apply sealant(SILICON KETONE HZ1213) to mating surface of lower case.（FIG.10-89）

（6）Install upper case to lower case by matching 3 shift forks with 3 grooves in synchronizer sleeve on main shaft respectively.（FIG.10-90）



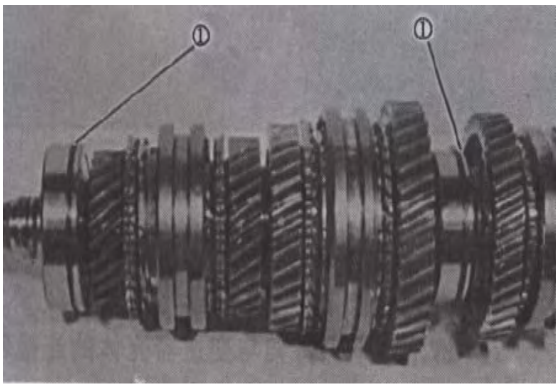


Fig 10-86

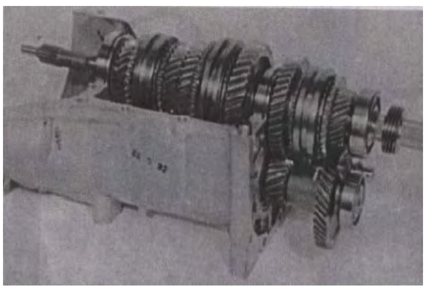


Fig 10-87

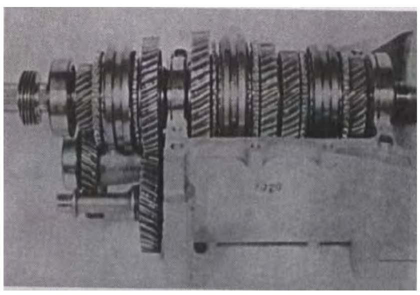


Fig 10-88

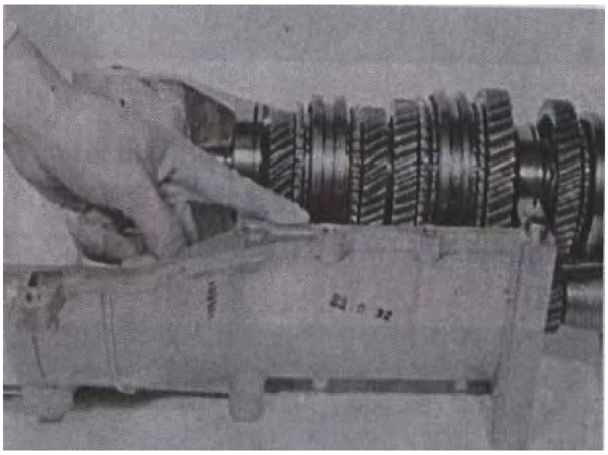


Fig　10-89

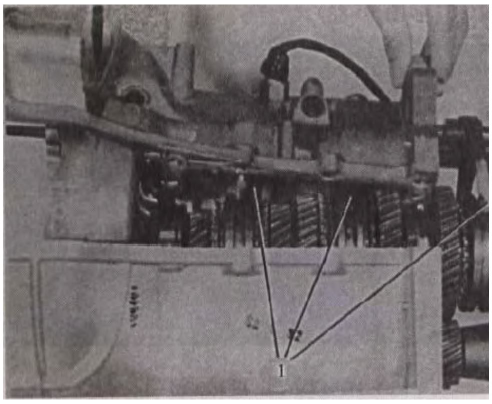


Fig　10-90

Shift fork：

（7）tighten case bolts to specification.（TABLE10-6）。

Table 10-6

Tightening torque for transmission case bolt	18~28N.m　(1.8~2.8kgf.m)

6) Extension Case

（1）Check to ensure that knock pins ① are fitted.（FIG0-91）。

（2）Apply grease(GREASE 201) to oil seal lip.

（3）Clean surface of extension case to mate with transmission case and uniformly apply sealant（SILICON KETONE HZ1213）（FIG.10-92）

（4）Make sure that 3 shift shafts are in neutral position as shown if FIG.10-37.

（5）install extension case to transmission case.

（6）Tighten case bolts to specification.（TABLE 10-7）

TABLE 10-7

Tightening torque for retainer bolts	18~28N.m　(1.8~2.8kgf.m)

（7）clean surface of gear shift lever ase to mate with transmission case and uniformly apply selant(SILICON KETONE HZ1213)(FIG.10-93）

（8）apply grease (GREASE 201) to speed meter driven gear and inside of its case. Install speed meter driven gear and case with driven gear case hole ① and extension case bolt hole ② aligned as shown in FIG..10-94

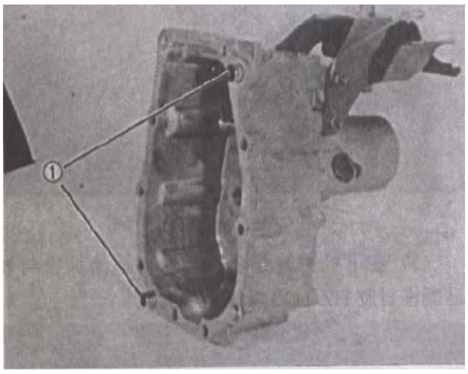


Fig　10-91

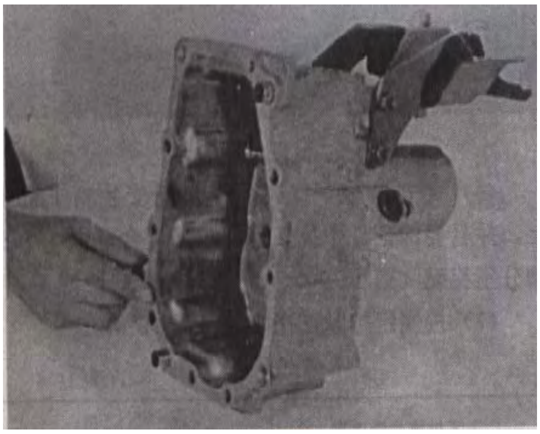


Fig　10-92

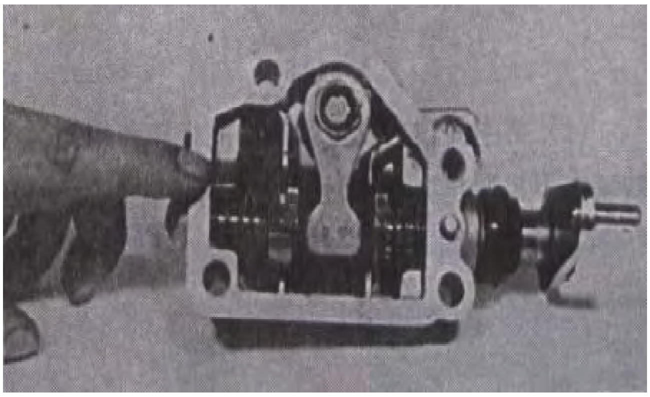


Fig　10-93

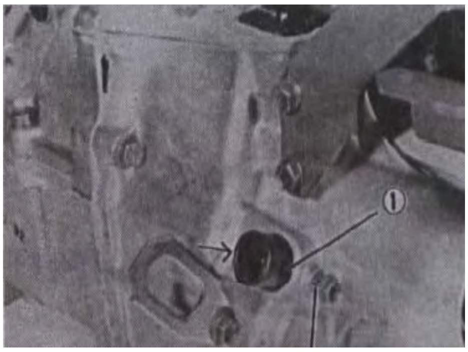


Fig.10-94

7）Input Shaft Bearing Retainer

（1）Apply grease(GREASE 201) to oil seal lip.

（2）Clean surface of retainer to mate with transmission case and uniformly apply sealant(SILICON KETONE HZ1213)（FIG.10-95）

（3）tighten retainer bolts to specification（TABLE 10-8）

Tightening torque for retainer bolts	18~28N.m　(1.8~2.8kgf.m)

（4）Check transmission input shaft for easy rotation by hand.

（5）Check each select and shift shaft for operation.

8）Clutch Release Bearing

Before installing bearing, apply grease（GREASE 201） to inner surface of clutch release bearing（FIG.10-96）

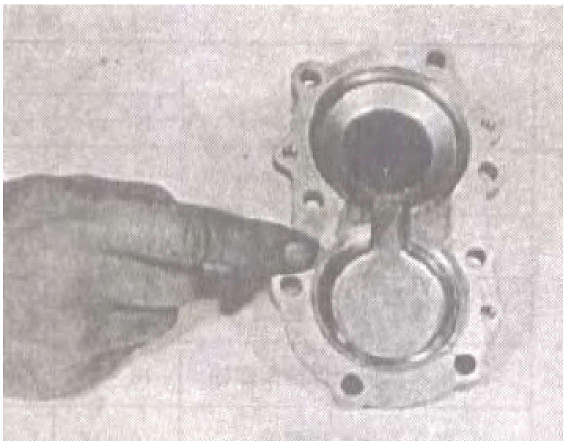


Fig 10－95

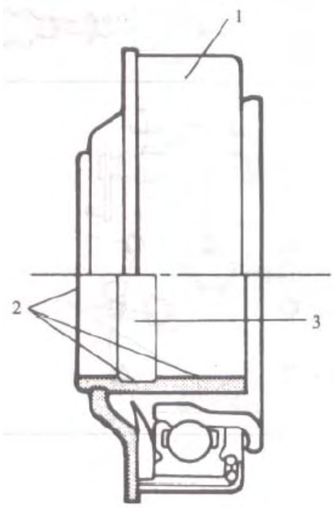


Fig　10-96

1-Clutch release bearing；2-Apply grease；3-Recess

9）Others

Upon completion or reassembly and installation of transmission ass’y in car body, pour specified amount of transmission oil into transmission, and check carefully for oil leakage.

●MAINTENANCE SERVICE

1）Transmission Oil

CAUTION
Apply sealant(SILICON KETONE HZ1213) to thread of oil filer and drain plugs and torque oil plugs to specification.（TABLE10-9）

TABLE 10-9

Tightening torque for oil drain and filter plug	36~50N.m　(3.6~5.0kgf.m)

Before changing oil, check for oil leakage first and correct defect. If any ,fill specified new oil in specified amount as shown in TABLE 10-10.

TABLE10-10

Oil capacity	1.3L
Oil specification	Gear oil, 85W/90 GL－4 or GL-5 GB13895-92A or NO.18 hyperbola

CARTION
For vehicles used in such area where the ambient temperature becomes lower than -15℃ during the coldest season, it is recommended that oils be changed with SAE80W or 70W/80~85 oils on such occasion of service as periodic maintenance.（FIG.10-97）

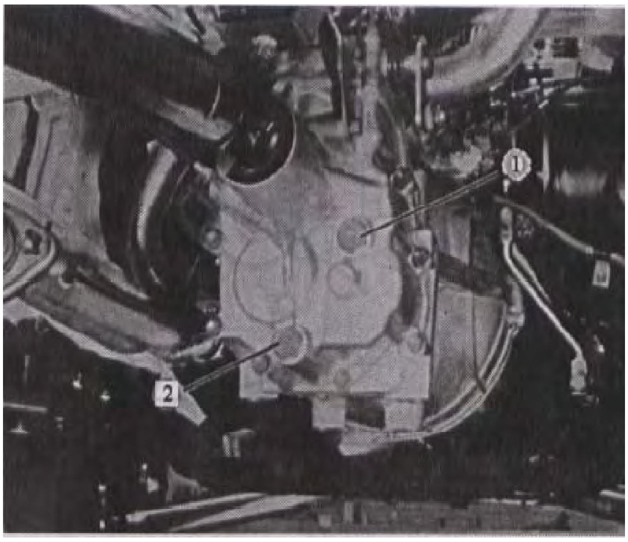


Fig　10－97

1-Oil filler plug；2-Oil drain plug

CAUTION
Whenever car was hoisted for any other service work than oil change, also be sure to check for oil leakage.

2）RECOMMENDED TORQUE SPECIFICATION

Be sure to torque each bolt according to specification shown in FIG. 10-98 and TABLE 10-11.

TABLE 10-11

System	Fastening parts	Tightening torque	
		N • m	kgf • m
	1．Gear shift lever case bolt	10～16	1.0～1.6
	2．Gear shift reverse check screw	22～35	2.2～3.5
	3．Gear select arm nut	18～28	1.8～2.8

	4．Reverse shift limit bolt	10～16	1.0～1.6
Transmission			
	5．Transmission case bolt	18～28	1.8～2.8
	6．Extension case bolt	18～28	1.8～2.8
	7．Transmission oil filter and drain plug	36～50	3.6～5.0
	8．Input shaft bearing retainer bolt	18～28	1.8～2.8
	9．Clutch release arm nut	10～16	1.0～1.6
	10．Speed meter driven gear case bolt	4～7	0.4～0.7

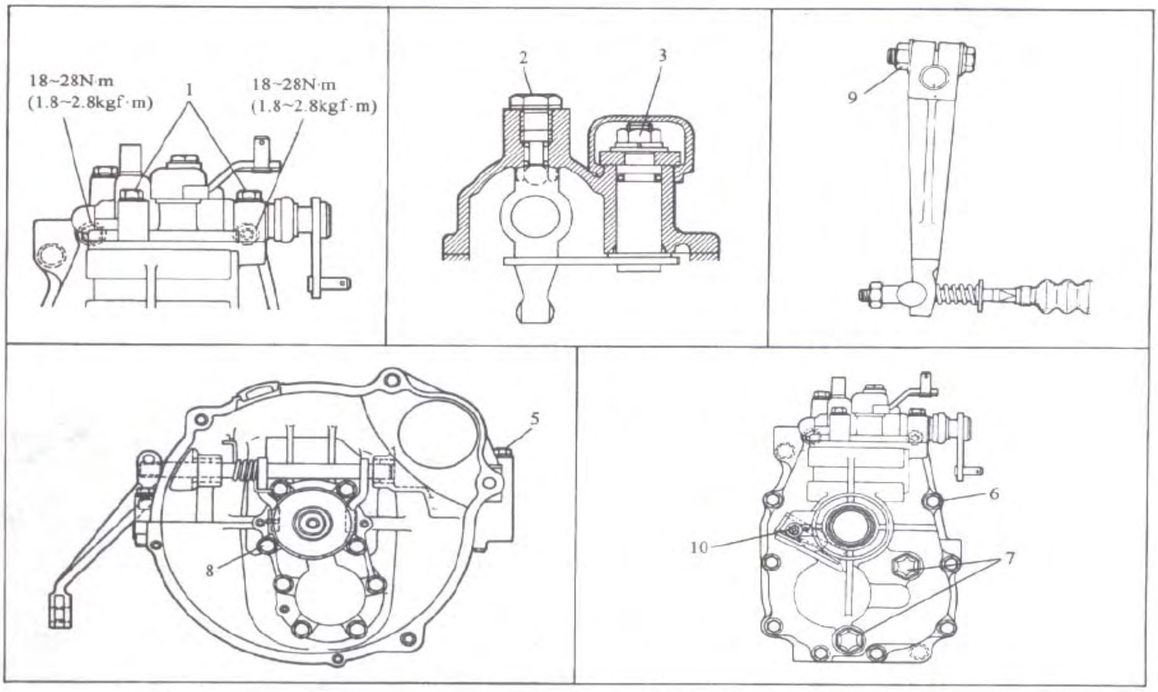


Fig　10－98

10.2　GEAR SHIFT CONTROL

- GENERAL DESCRIPTION

The gerar shifting control system consists of following main parts as shown in FIG. 10-99.

REMOVAL

1）Gear Shift Control Lever

（1）Disconnect centre console box.

（2）Disconnect gear shift cable ① and select cable ②from gear shift control lever and loosen bolt（FIG.10-100）

2）Gear Shift and Select Cable

（1）Disconnect gear shift and select cables from shift shaft lever and select shaft lever.（FIG.10-101）

（2）Remove centre console box.

（3）disconnect gear shift cable and select cable from gear shift control lever and bracket （FIG.10-102）

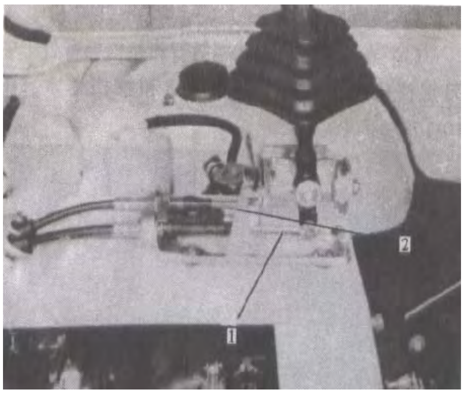


Fig 10-100

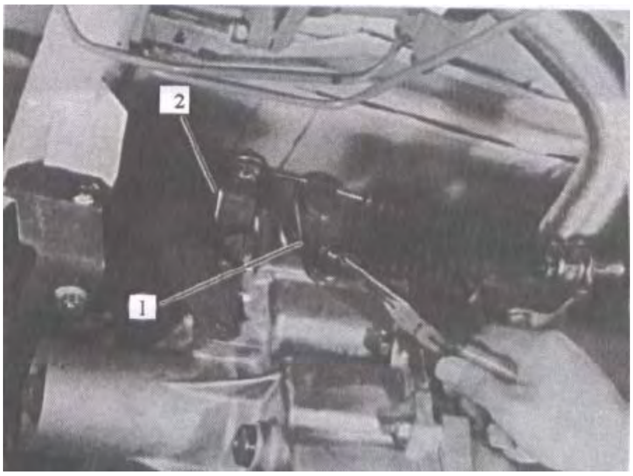


Fig 10-10

1-Gear shift shaft lever；2-Gear shift shaft lever

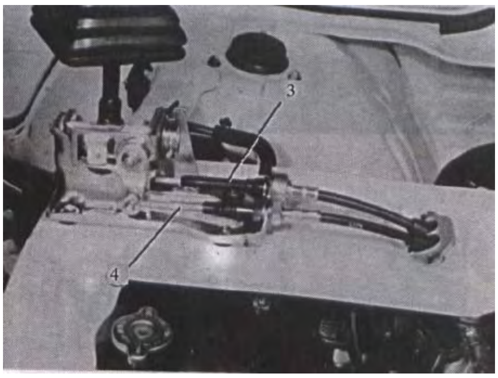


Fig 10-102

3-Gear shift cable；4-Select cable

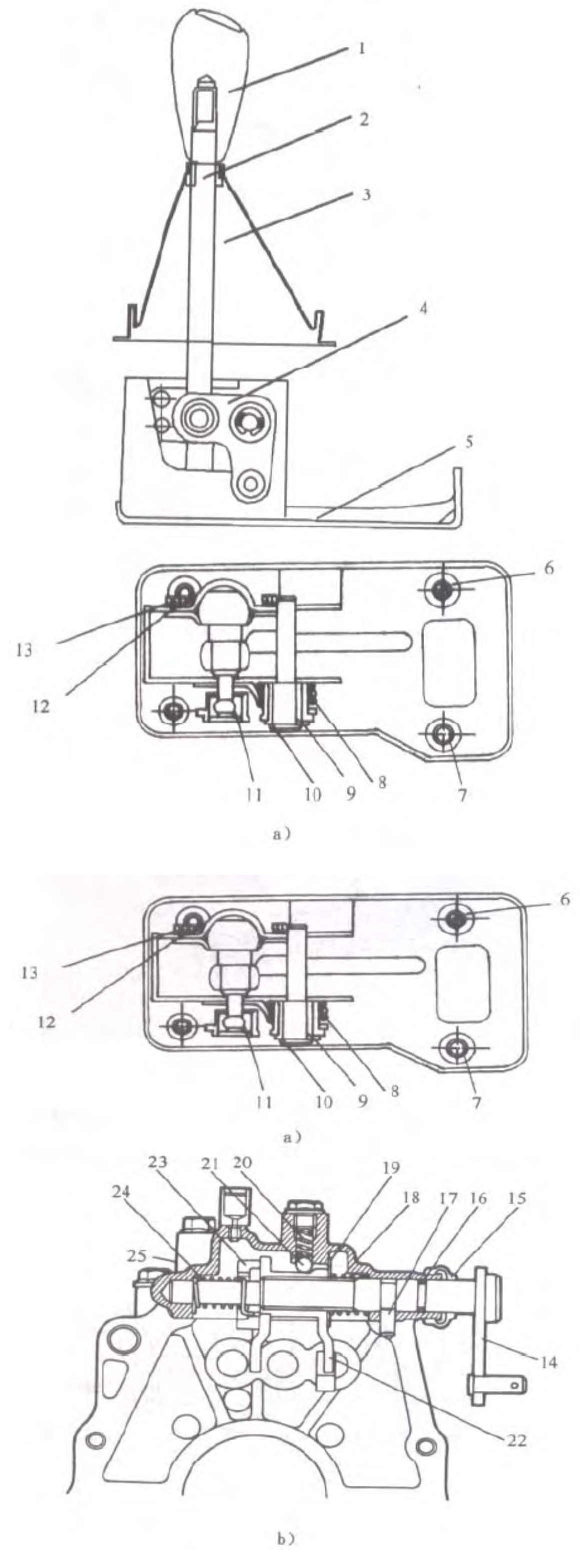


Fig　10-99

1- Cranker；2-Gear shift control lever；3-Boot；4—Shift arm；5-Bottom seat；6-Mat；7-Guide bush；8-Return spring；9-Lever yoke bush；10-Spacer；11-Bush；12-Washer；13-Bolt；14-Gear shift shaft lever；15-Shaft boot；16-Shaft O-ring；17-Lever case pin；18-Shift lever hold NO.1 spring；19-Lever hold washer；20-Reverse check spring；21-Reverse check ball；22-Gear sift lever；23-Reverse shift limit dog；24-Shift lever hold No.2 spring；25-Reverse gear shift lever case

3）Gear Shift Lever Case

（1）Make sure that gear shift control lever is in neutral position and disconnect gear shift and select cables from shift shaft lever and select shaft lever.（FIG.10-103）

（2）Remove gear shift lever case from transmission case（FIG.10-104）

（3）Remove select shaft lever and select shaft.（FIG.10-105）

（4）Remove reverse check screw, coil spring and reverse check ball from case.（FIG.10-106）

（5）Pull out shift lever case pin from case（FIG.10-107）

（6）Pull out gear shift shaft from case. By pulling out gear shift shaft, No. 2 spring, gear shift lever, washer and No. 1 spring can be removed.（FIG.10-108）

（7）Remove reverse shift limit dog.（FIG.10-109）

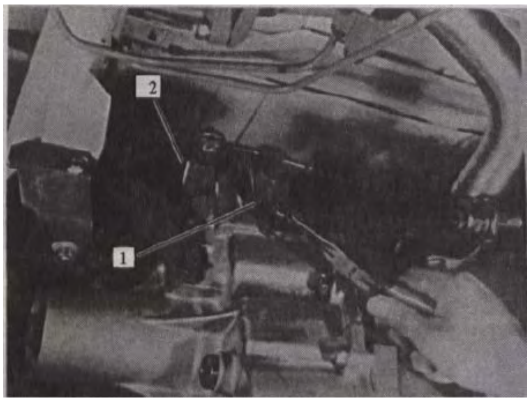


Fig　10-103

1-Gear shift lever；2-Gear select lever

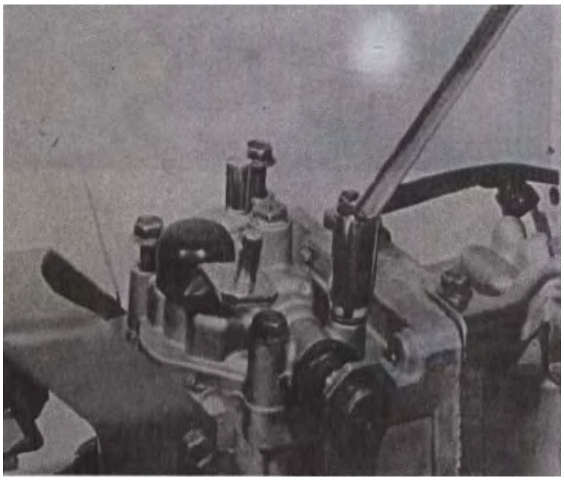


Fig　10-104

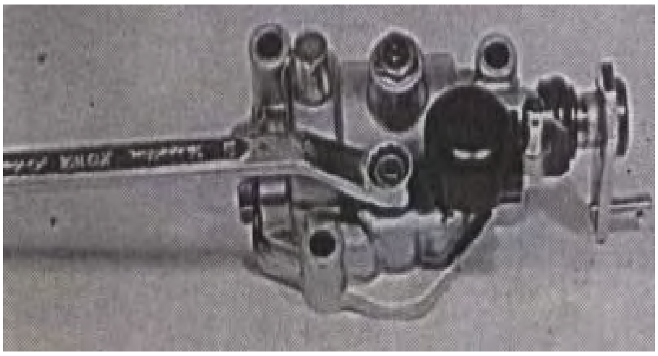


Fig10-105

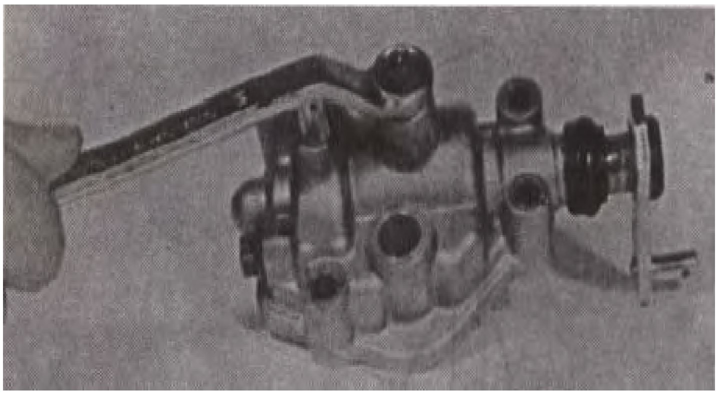


Fig　10-106

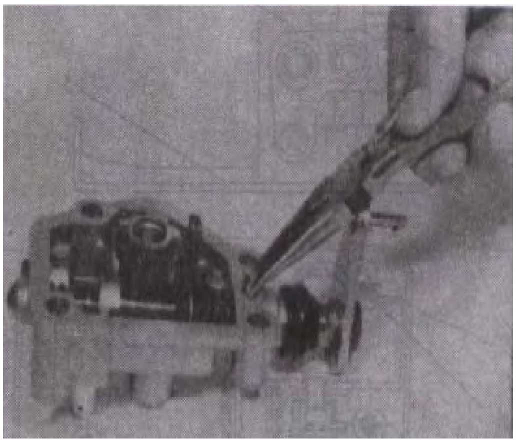


Fig　10-107

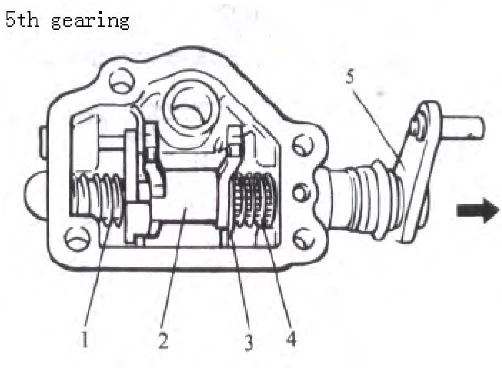


Fig　10-108

1. Shift lever hold No. spring；2-Gear shift shaft；3-Washer；4-Shift lever hold No. 1 spring；5- Shifting arm

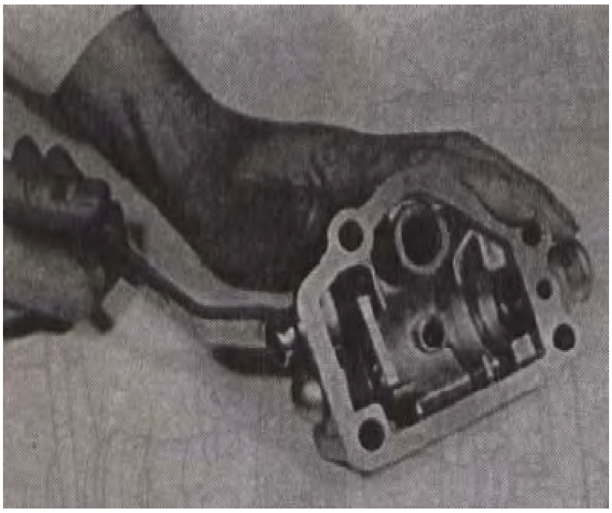


Fig　10-109

Fig　10-110

1-Gear shift lever；2-Gear select lever；3-Reverse shift limit dog（5-speed type）

- INSPECTION OF COMPONENTS

1）Gear Shift Lever And Select Lever

Check each lever end for wear and replace if defective. With 5th type transmission, also check reverse shift limit dog for wear.（FIG.10-110）

2）Gear Shift Shaft O-Ring, Shaft Boot And Select Shaft Oil Seal

Check each part for wear, damage and deformation and replace if found defective.

Use of new O-ring and oil seal is recommended for reassembly.（FIG.10-111）

3) Spring

Check each spring for weakness and breakage and replace if found defective.（FIG.10-112）

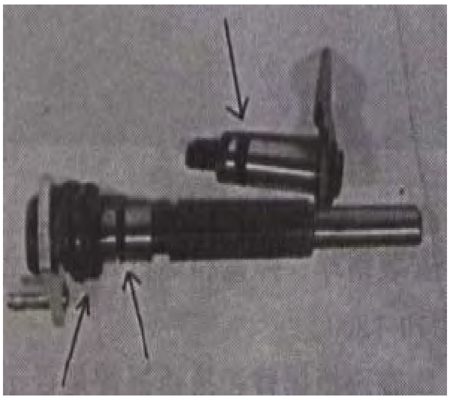


Fig　10-111

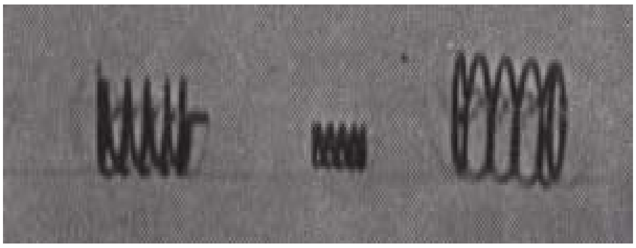


Fig　10-112

4）Gear Shift Fork Shaft

Visually check each gear shift fork shaft (High, Low and Reverse) where gear shift lever contacts, for wear. Worn shaft must be replaced.（FIG.10-113）

5）Gear Shift Control Lever and Bracket

Check each bush, washer and joint for wear. Replace if found defective.

Apply grease if lever doesn't move smoothly.（FIG.10-114）

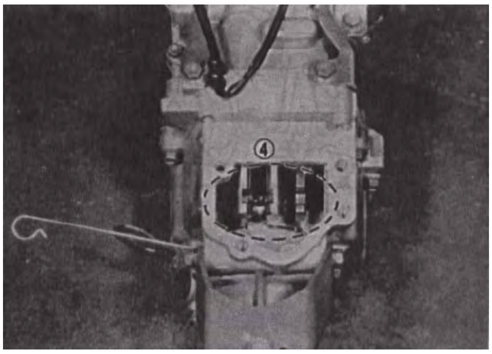


Fig　10-113

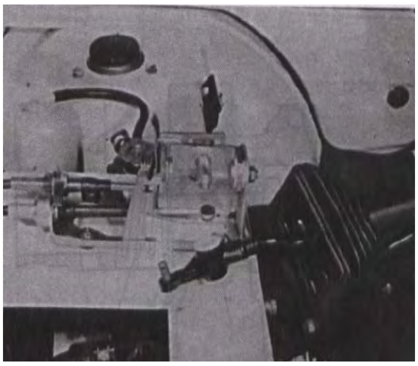


Fig　10-114

- INSTALLATION

Gear shift lever is installed by reversing removal procedure. Some important steps will be explained in detail.

CAUTION
Be sure to apply gear oil to all parts before installing them into gear shift lever case.

1）Gear Shift Lever Case

（1）Install reverse shift limit dog referring to FIG. 10-115 for installation direction

（2）Install No.2 spring, gear shift lever and washer and No.1 spring to case. Refer to FIG.

10-116,FIG.10-117 For installation direction of No.2 spring and gear shift lever.

（3）Insert gear shift shaft into shift lever case until groove “A” in shift shaft aligns with pin hole “B” in shift lever case. Make sure that gear sift lever and gear shift shaft lever are at the same installation angle.（FIG.10-118）。

（4）Install gear select shaft and tighten select shaft nut to specified torque.(TABLE 10-12, FIG.10-119)

TABLE 10-12

Tightening torque for select shaft nut	18～28N·m（1.8～2.8kgf·m）

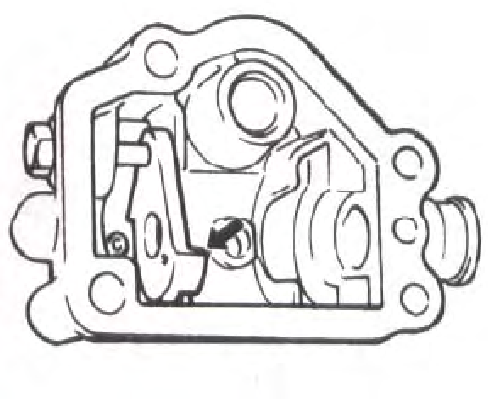


Fig 10-115

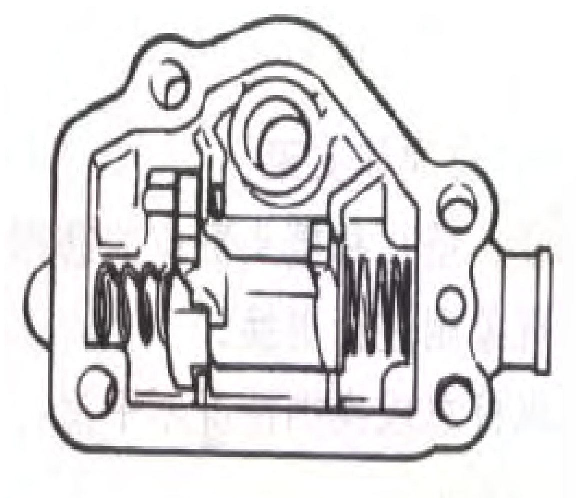


Fig 10-116

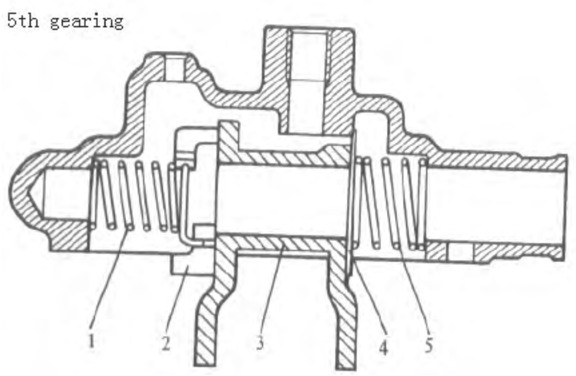


Fig 10-117（5-speed type）

1-No.2 spring；2-Reverse shift limit dog；3-Gear shift lever；4-Washer ；5-No. 1 spring

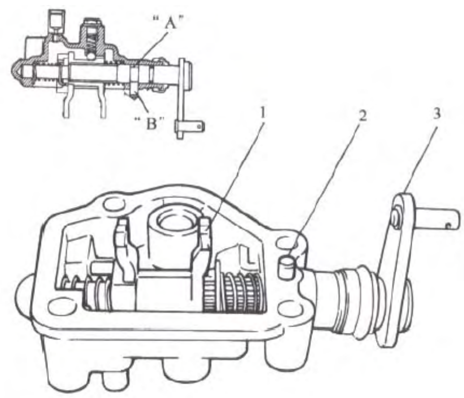


Fig 10-118

1．Gear shift lever；2-Lever case pin；3-Gear shift shaft lever

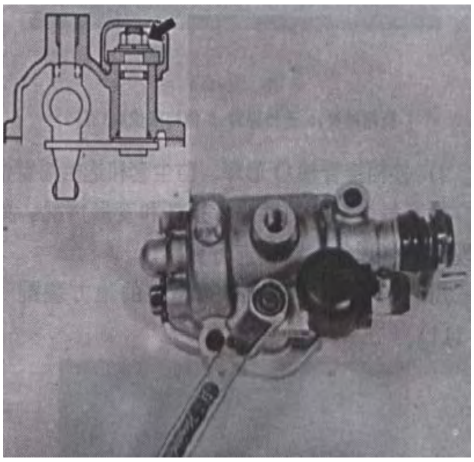


Fig 10-119

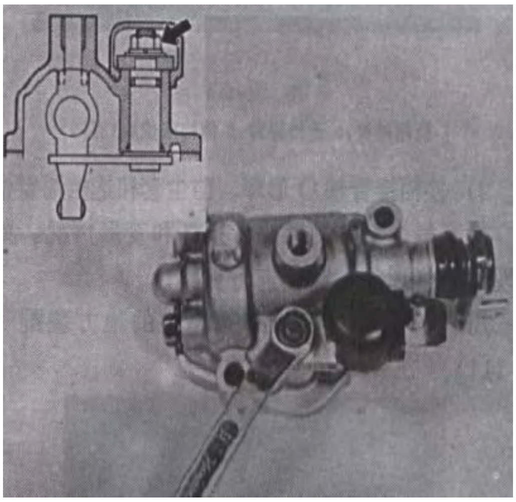


Fig 10-120

（5）Install ball, spring and screw and tighten screw to specified torque.（FIG.10-120）
（6）Check select shaft lever and shift shaft lever for smooth and correct movement into each range position.
（7）When installing lever case to transmission extension case, clean joint faces, and then apply sealant(SILICON KETONE HZ1213) to joint faces.（FIG.10-121）。
（8）Tighten gear shift lever case bolt to specified torque.（TABLE 10-13）。

Table 10-13

Tightening torque for lever case bolt	10～16N·m（1.0～1.6kgf·m）

（9）Connect select cable ① and shift cable ② to respective levers, making sure not to confuse them.（FIG.10-122）
（10）After connecting cables, operate gear shift control lever to check if it shifts and selects each range correctly and smoothly. If it doesn’t, refer to MANITENANCE SERVICE of this section.

2）Gear Shift Control Cable And Lever

Install by reversing removal procedure. Also, use care for the following.

（1）Washer and Bush

be sure to install washer and bush in correct installation positions and apply GREASE 201 to each greasing point indicated in FIG.10-123.

（2）Cable

when connecting shift cable and select cable to control lever or lever on transmission case, do not confuse their connecting positions, refer to FIG.10-123 for correct connection.

After installing all parts, check if control lever shifts and selects each range correctly and smoothly.

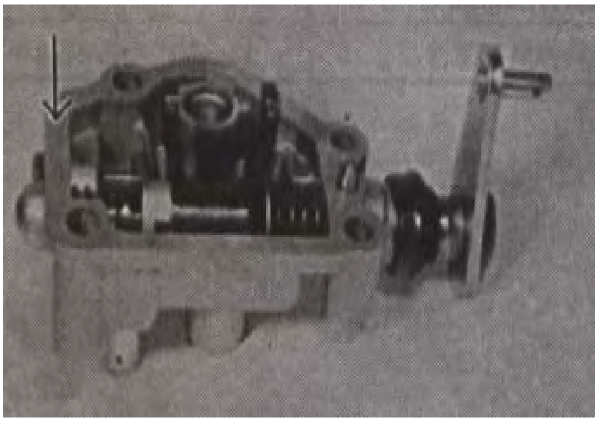


Fig 10-121

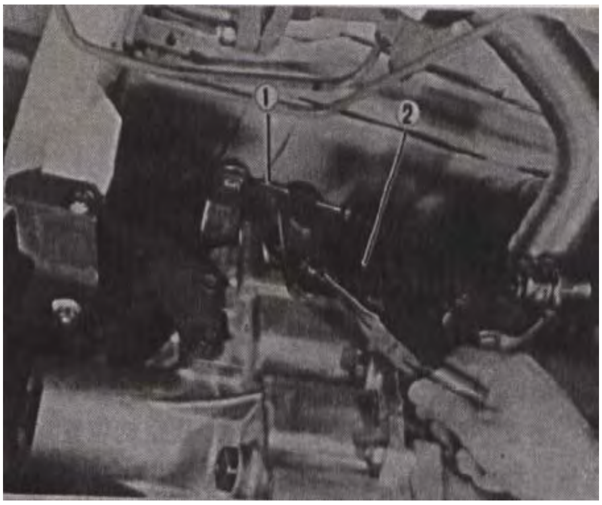


Fig 10-122

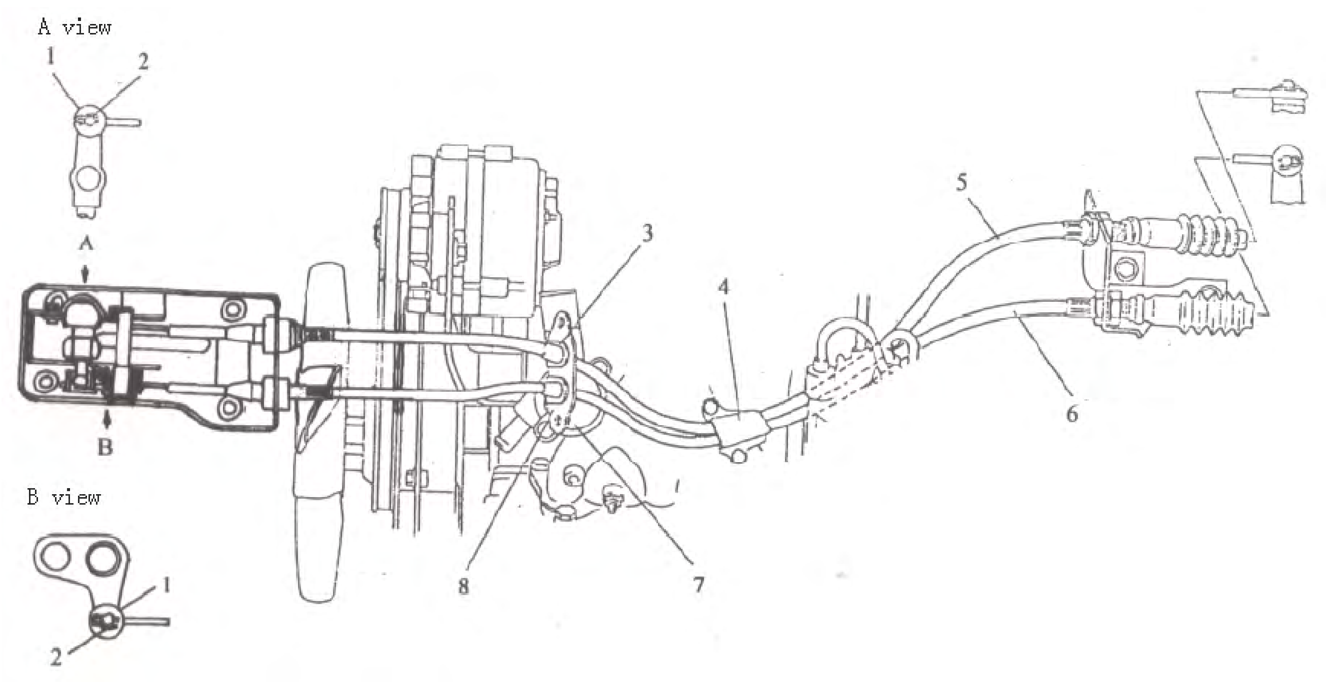


Fig 10-123

1-Washer ；2-Cable end pin；3-Cable grommet；4-Cable guide；5-Gear shift control cable；6-Gear select control cable ；7-Apply No. 50 sealant Q/1-BNYJ50-88；8-Gear control cable grommet plate

- MAINTENANCE SERVICE

Select Cable Adjustment：

CAUTION
① Before adjustment, check to make sure that each greasing point as indicated in FIG.10-123 is greased properly and that bush and other parts are not worn. Correct as necessary
② Gear shift cable need not to be adjusted.

If gear shift control lever can e shifted from neutral (vertical) position to and between 3rd and

4th positions smoothly, gear select case is well-adjusted.

If smooth shifting from neutral position to and between 3rd and 4th positions is not obtained, adjust select cable as follows.：

（1）tilt control lever a little toward low and 2nd position side from neutral position. If it can be shifted smoothly to and between 3rd and 4th positions from there, loosen select cable adjusting nut at the right and tighten nut until control lever can be shifted smoothly to and between 3rd and 4th positions from neutral position.

（2） Tilt control lever a little toward reverse side from neutral position. If it can be shifted smoothly to and between 3rd and 4th positions from there, loosen select cable adjusting nut and then tighten nut until control lever can be shifted to and between 3rd and 4th positions smoothly from neutral position.

TABEL10-14

Fastening parts	Tightening torque	
	N • m	kgf • m
1． Reverse limit bolt	10～16	1.0～1.6
2． Reverse check ball screw	22～35	2.2～3.5
3． Gear select shaft lever nut	18～28	1.8～2.8
4． Gear shift lever case bolt	10～16	1.0～1.6
5． Gear shift control lever nuts	18～28	1.8～2.8

11 CLUTCH

11.1 GENERAL DESCRIPTION

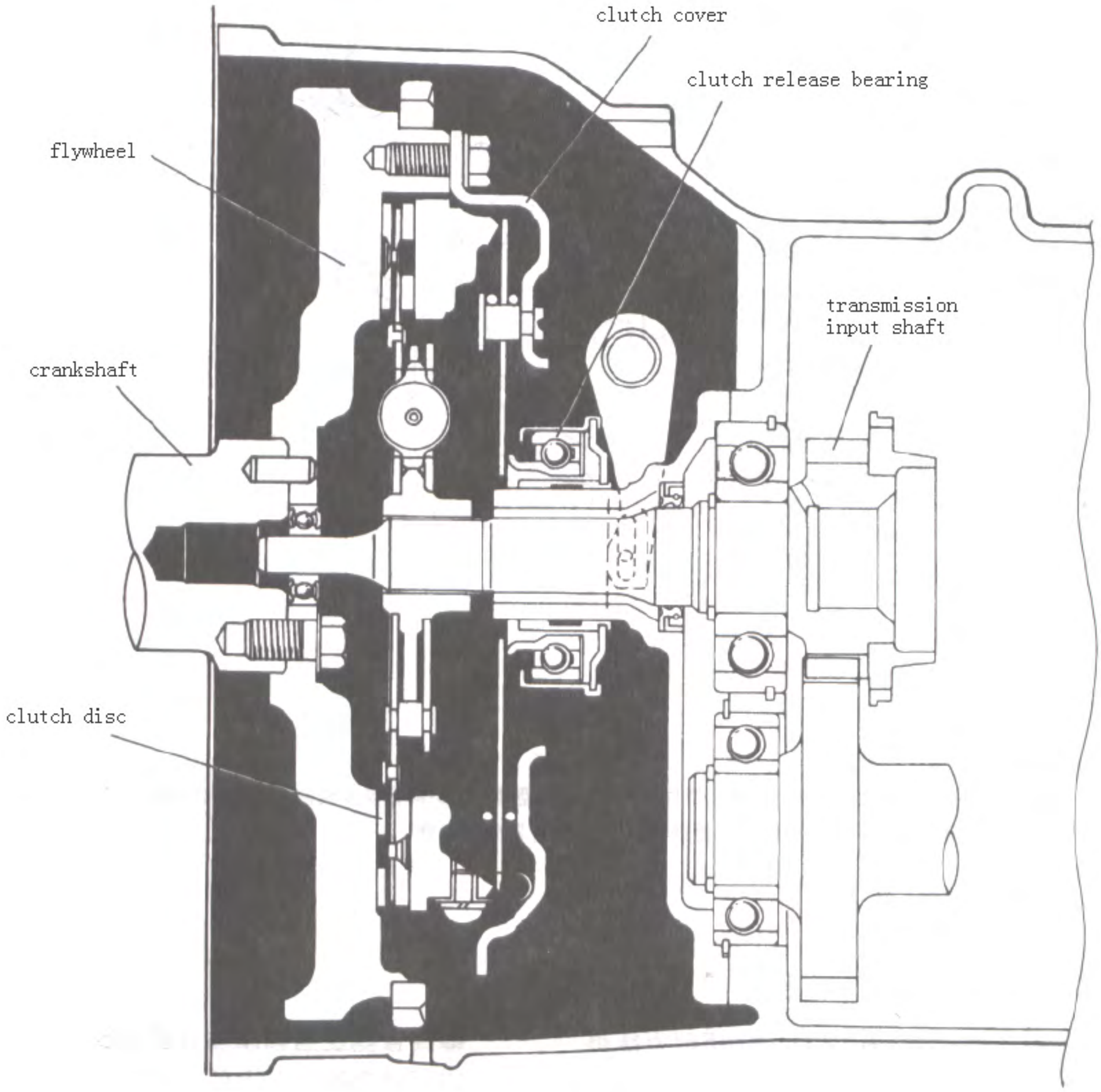
The clutch is a diaphragm-spring clutch of a dry single disc type. The diaphragm spring is of a tapering-finger type, which is a solid ring in the outer diameter part, with a series of tapering fingers pointing inward. The disc, carrying four tensional coil springs, is mounted on the transaxle input shaft with a serration fit.

The clutch cover is fixed to the flywheel， and carries the diaphragm spring in such a way that the peripheral edge part of the spring pushes on the pressure plate against the flywheel, when the clutch release bearing is held back.

This is the engaged condition of the clutch.

Depressing the clutch pedal causes the release bearing to advance and pushes on the tips of the tapering fingers of the diaphragm spring.

When this happens, the diaphragm spring pulls the pressure plate away from the flywheel, thereby interrupting the flow of drive from flywheel through clutch disc to transaxle input shaft.， (FIG.11-1a), 11-1b))


clutch cover
clutch release bearing
flywheel
transmission input shaft
crankshaft
clutch disc

a)

FIG.11-1a)

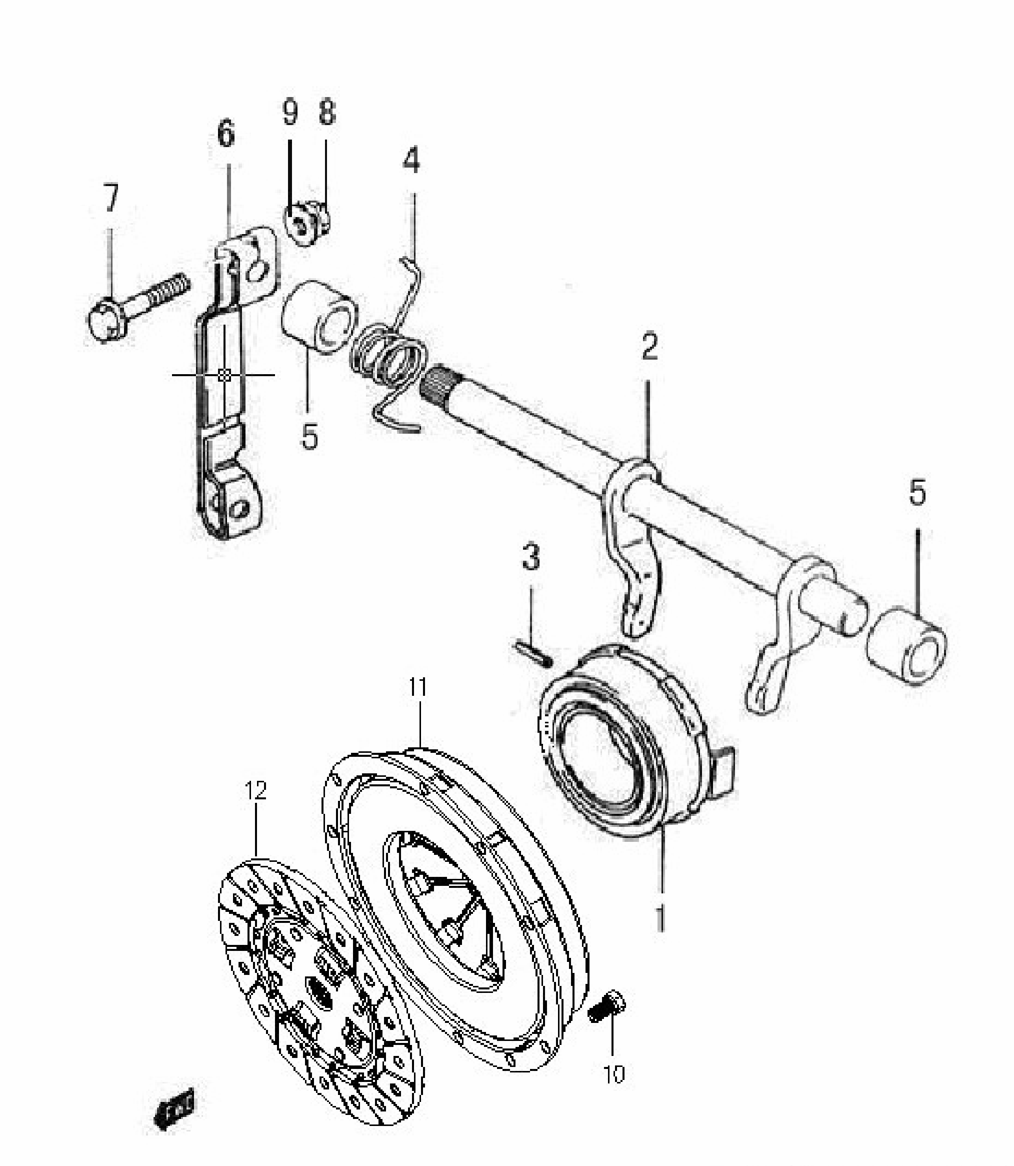


FIG.11-1b)

1-Clutch disc；2-Clutch cover；3-Washer；4-Cluthc cover bolt；5-Clutch release bearing；6-Clutch release fork;7-Bush；8-Clutch release shaft ；9-Return spring；10- Beset bolt；11-Clutch release arm

11.2 REMOVAL

Remove transmission referring to section 10, before removing clutch.

●Clutch Cover And Disc Removal

Remove the six bolts on clutch cover, and take down clutch cover an disc assembly.（FIG.11-2）。

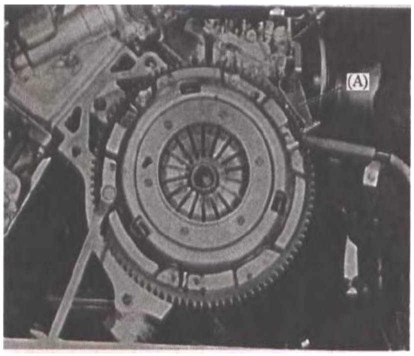


FIG.11-2

（A）Special tool（flywheel holder）

●Clutch Release Bearing Removal

Remove release bearing from retainer of transmission input shaft.（FIG.11-3）。

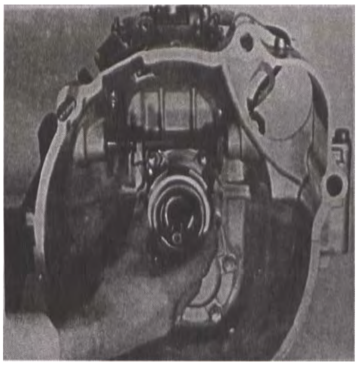
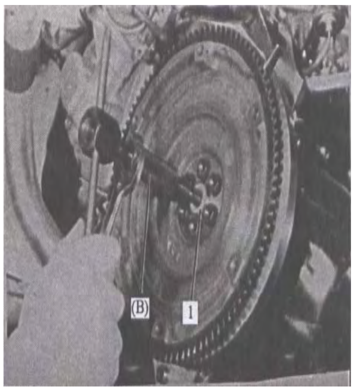


FIG.11-3



1-Input shaft bearing;（B）-Special tool（bearing remover）

●Input End Bearing Removal

Remove the bearing using bearing remover(FIG.11-4)

●Clutch Release Shaft Bush Removal

Refer to section 10"clutch and gear shift”

11.3 INSPECTION

●Clutch Driven Disc Surface Inspection

Polish ablated or wear surface using No.120-200 sand paper，

If the wear is out of specification, replace cover assembly.（FIG.11-5）。

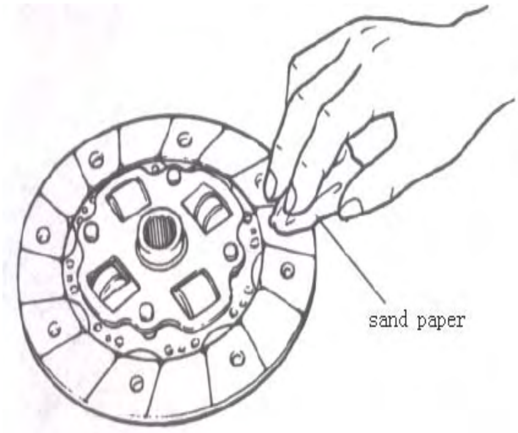


FIG.11-5

●Clutch Disc Surface Wear Inspection

Check the wear of the facing by measuring the depth of each rivet head depression, which is the distance between rivet head and facing surface. If the depth is found to have reached the service limit at any of the holes, replace the clutch disc assembly.（FIG.11-6）.The standard value of rivet head depth is 1.2mm and the service limit is 0.5mm.

● Spline Side Clearance Inspection

Rotate disc to check spline side clearance. Replace spline if the side clearance is out of service limit. When using micrometer, measure the circumference displacement.（FIG.11-7）Service limit of splint side clearance is 0.8mm。

● Clutch Pressure Plate Inspection

Check rivet of diaphragm-spring for looseness. replace clutch pressure plate if necessary so as to avoid vibration or noise of pressure plate.

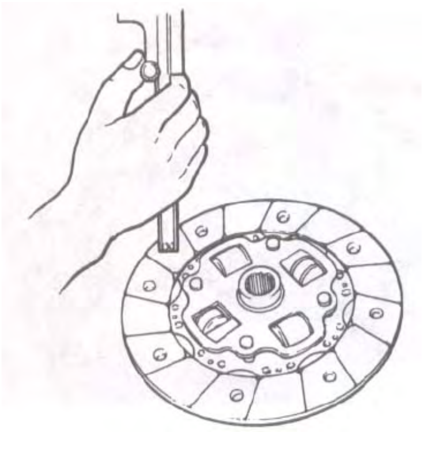


FIG.11-6

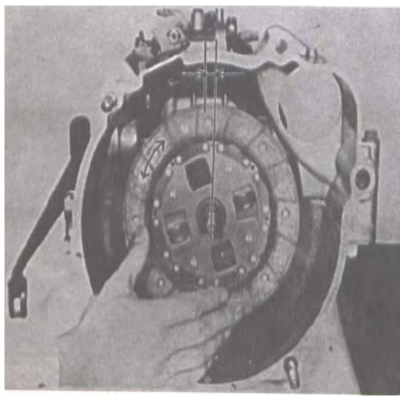
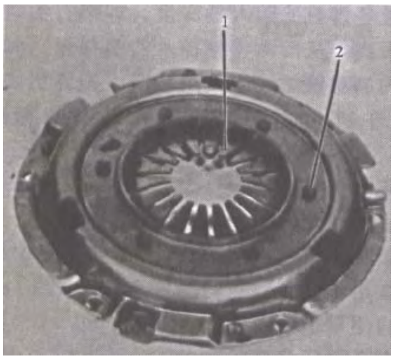


FIG.11-7



1- Wore diaphragm-spring tapering end 2-Rivet

Fig11-8

Check diaphragm-spring tapering end for wear. (Release bearing act pressure to it to release clutch) replace clutch cover if excessive wear if found. （ FIG. 11-8）

●Release Bearing Inspection

Turn the release bearing with hand. Check for rough rotation, vibration or noise. If any malcondition is found, replace it（FIG.11-10）（FIG.11-9）

●Input Shaft Bearing Inspection

Turn the release bearing with hand. Check for rough rotation, vibration or noise. If any malcondition is found, replace it.（FIG.11-10）

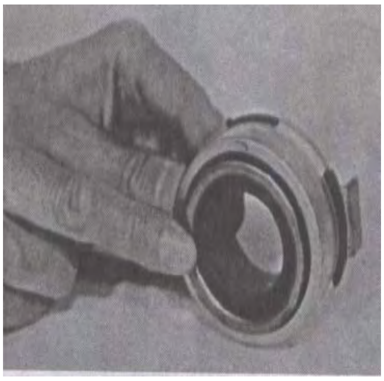


FIG.11-9

FIG.11-10

●Flywheel Inspection

check the surface contacting clutch disc for any wear or damage（FIG.11-11）。

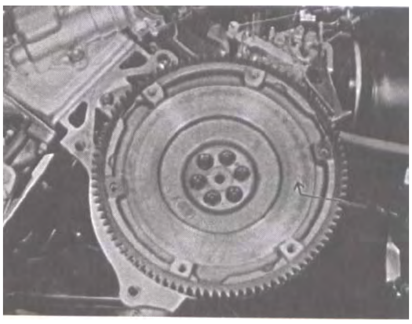


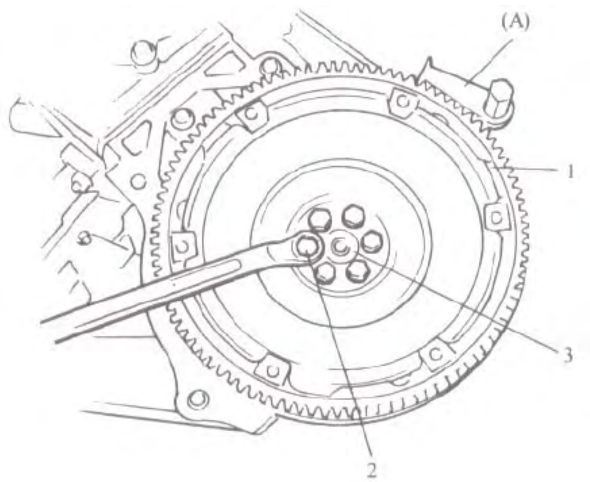
FIG.11-11

11.4 INSTALLING

It is the reverse of removal. Install point：

1）Flywheel Installation

（1） tighten bolt to specification（FIG.11-12，table11-1）.



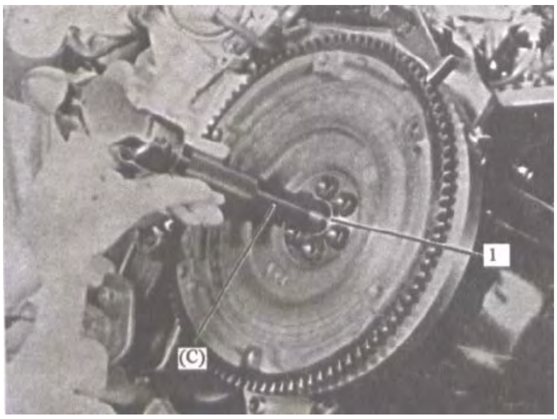
1-Flywheel；2-Flywheel bolt；3-Input shaft bearing；（a）Special tool（flywheel holder）

FIG.11-12

Table 11-1

Tightening Torque For Flywheel Bolts	N.m	Kgf.m
	40~45	4.0~4.5

(2) Install input shaft end bearing to flywheel using bearing installer.（FIG.11-13）



1- Input shaft bearing；（c）Special tool（input shaft bearing installer）

FIG.11-13

2）Clutch Disc And Cover Installation

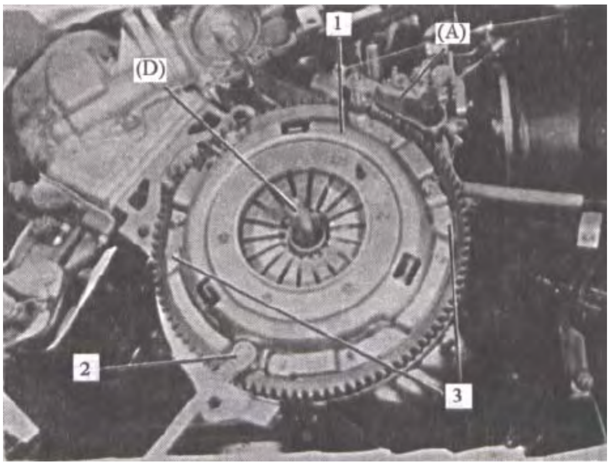
（1）Using special tool(clutch center guide), install the clutch disc and clutch cover.

(2) Using special tool(flywheel holder)， fix the flywheel. Tighten clutch cover bolt to specified torque，table 11-2.

Table 11-2

Tightening torque for clutch cover bolts	N.m	Kgf.m
	18~28	1.8~2.8

Install clutch cover on flywheel. Do not forget to install two beset bolts.（FIG.11-14）。



1-Clutch cover；2-Clutch cover bolt；3- Beset bolt

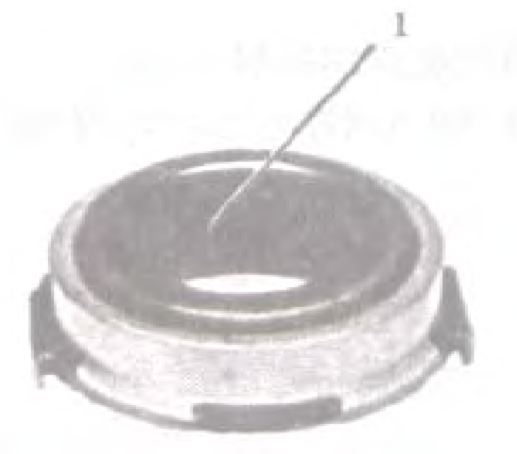
（a）Special tool（flywheel holder）

（d）Special tool（clutch center guide）

FIG.11-14

3）Clutch Release Bearing Installation

Apply grease to inner surface of it, before installing bearing（FIG.11-15）

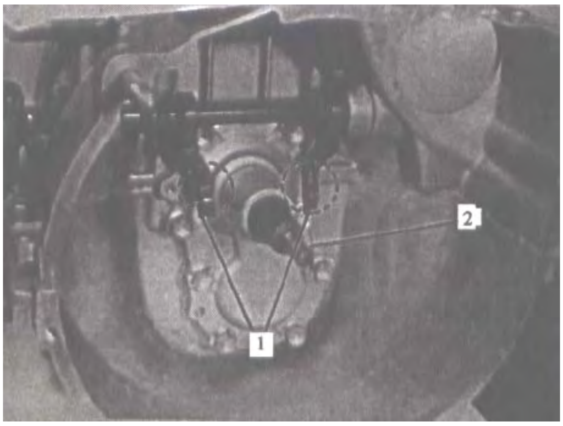


1-Grease（super grease“a”）

FIG.11-15

4）Clutch Release Shaft Fork

Apply grease to release fork end and input shaft（FIG.11-16）。



1-Grease （super grease“a”）；2-Grease （super grease“1”）

FIG.11-16

5）Clutch Release Arm Installation

Align punch mark on clutch release arm with punch mark on release shaft（FIG.11-17）。

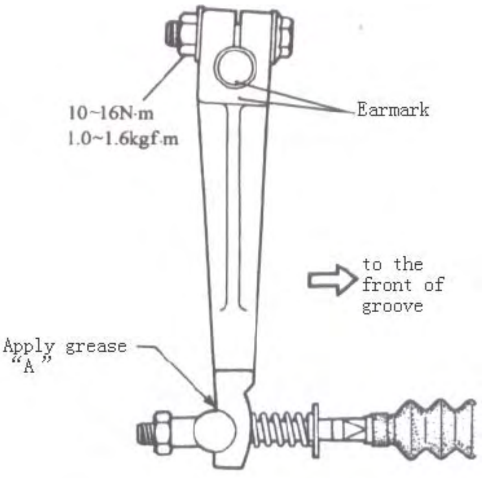


FIG.11-17

6）Clutch Release Shaft Bush Installation

Reinstall bush referring to section 10.1.

7）Transmission Installation

INSTALL transmission referring to section 10.

11.5 Service

1 Clutch Pedal Free Travel

(1) Depress the clutch pedal until the beginning of clutch resistance is felt, and measure the distance (Clutch pedal free travel).

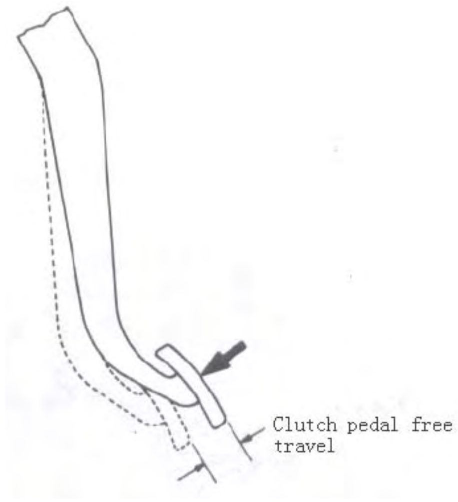


FIG.11-18

The free travel should be satisfied with Fig
the inspection in TABLE 11-5 .(FIG.11-18)

TABLE 11-5

Clutch Pedal Free Travel	20~30mm

(2) If the free travel is out of specification, adjust it with clutch cable outer nuts. (Pedal and release arm side)

2 Clutch cable lubrication

Apply grease to the hook part and pin of clutch cable.

11.6 CLUTCH REMOVAL AND INSTALLATION（DA471QLR ENGINE）

11.6.1 General Description

The clutch is a diaphragm-spring clutch of a dry single disc type. The diaphragm spring is of a tapering-finger type, which is a solid ring in the outer diameter part, with a series of tapering fingers pointing inward. The disc, carrying four tensional coil springs, is solidably mounted on the transaxle input shaft with a serration fit.

The clutch cover is secured to the flywheel， and carries the diaphragm spring in such a way that the peripheral edge part of the spring pushes on the pressure plate against the flywheel, when the clutch release bearing is held back.

This is the engaged condition of the clutch.

Depressing the clutch pedal causes the release bearing to advance and pushes on the tips of the tapering fingers of the diaphragm spring.

When this happens, the diaphragm spring pulls the pressure plate away from the flywheel, thereby interrupting the flow of drive from flywheel through clutch disc to transaxle input shaft.

11.6.2 Removal And Installation

● Clutch Cover, Disc And Flywheel（FIG.11-19）

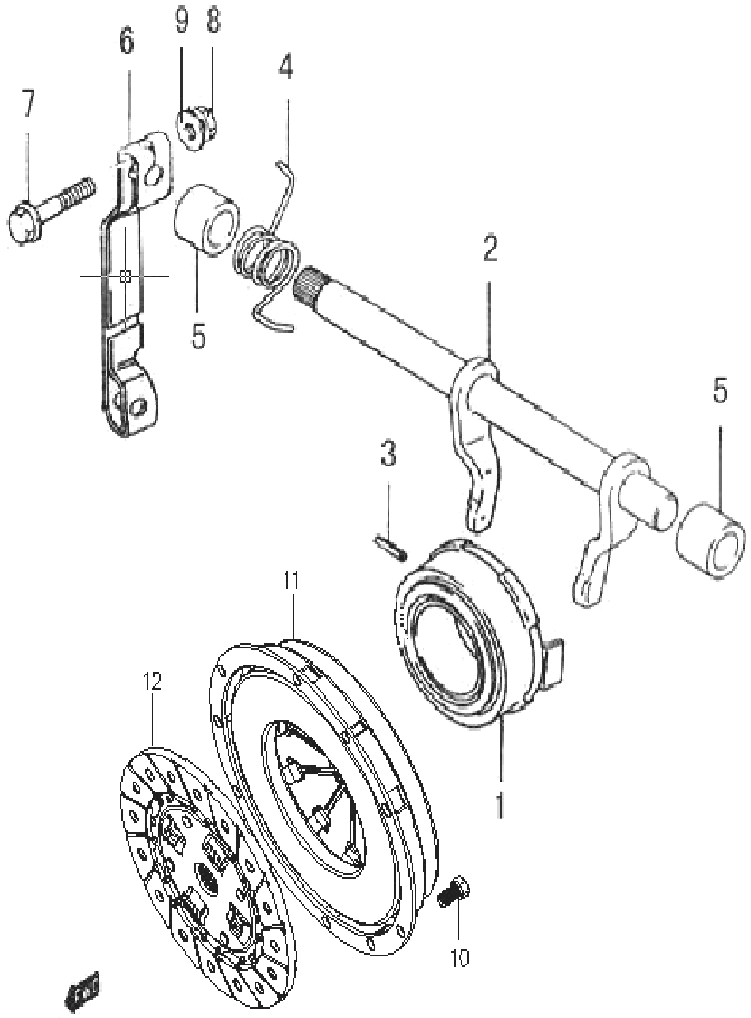


FIG.11-19

1、clutch release bearing 2、clutch release shaft 3、clutch release fork pin 4、return spring
5、bushing 6、clutch release lever 7、 bolt 8、nut
9、lock washer10、bolt 11、clutch disc12、clutch cover

1. Removal

Remove transmission before removing clutch.

1）clutch cover and driven plate

After removing 6 bolts from clutch，take down clutch cover and driven plate from flywheel.(FIG.11-20)

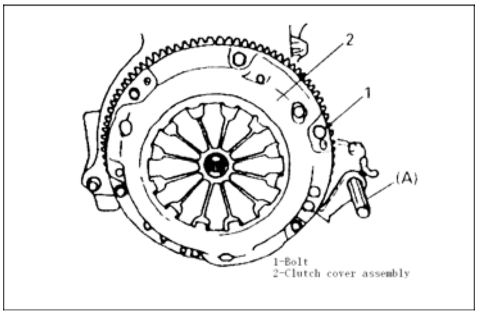


FIG.11-20

2）Clutch Release Bearing

Remove release bearing from transmission input shaft. (FIG.11-21)

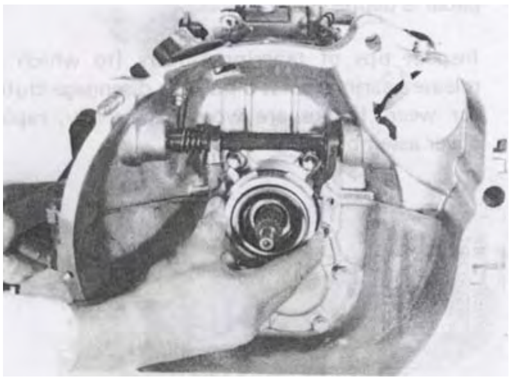


FIG.11-21

3）Input Shaft And Bearing

Pull bearing using special tool (FIG.11-22)

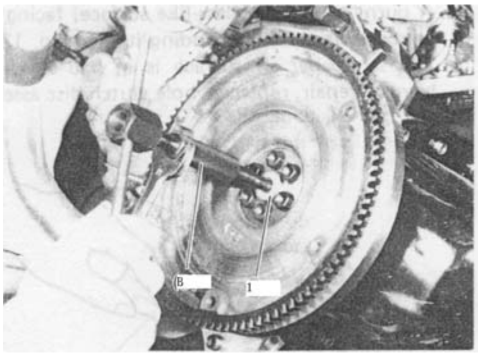


FIG.11-22

1- Input shaft bearing

(b)Special tool (bearing remover)

4）Clutch Release Shaft Bush

Replace release shaft bush referring to correlative section.

2. Inspection

1）Clutch driven disc surface inspection

polish ablated or wear surface using No.120-200 sand paper(FIG.11-23)

If the wear is out of specification, replace cover assembly.

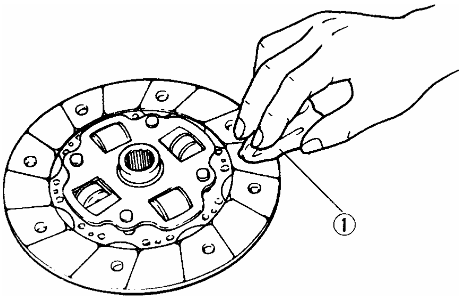


FIG.11-23

2）Clutch Surface Wear

Measuring the depth of each rivet head depression, which is the distance between rivet head and facing surface.

If the depth is found to have reached the service limit at any of the holes, replace the clutch disc assembly.(FIG.11-24) The standard value of rivet head depth is 1.2mm and the service is 0.5mm.

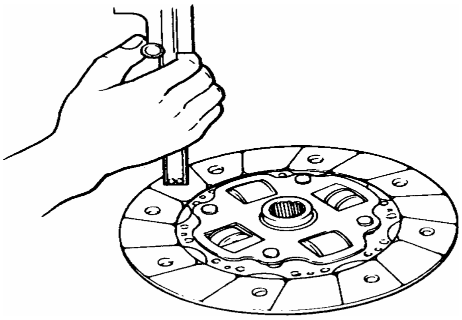


FIG.11-24

3）Clutch Cover

Check the diaphragm spring release finger(contact portion with release bearing) for wear. If the spring excessively worn, replace the clutch cover assembly. If depress clutch pedal, the noise of click is found, replace clutch cover(FIG.11-25)

FIG.11-25

4）Release Bearing

Turn the release bearing with hand. Check for rough rotation, vibration or noise. If any malcondition is found, replace it.(FIG.11-26)

FIG.11-26

5）Input shaft bearing

Turn bearing quickly. check for rough rotation or noise.If any malcondition is found, replace it(FIG.11-27)

FIG.11-27

6）Flywheel

Check the surface contacting with clutch disc for wear or damage(FIG.11-28)

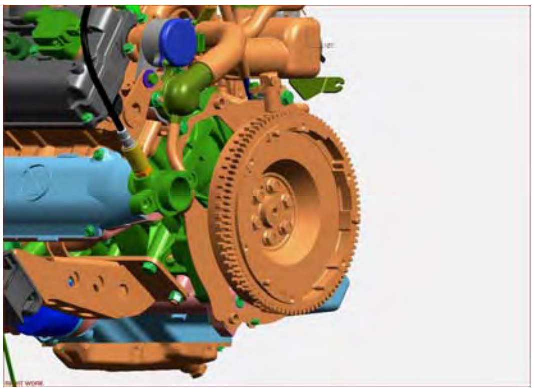


FIG.11-28

3.Installation

It is the reverse of clutch cover removal. Pay attention to the followings.

1）Flywheel

a) Install crankshaft bolt

Tightening torque：40—45 N • m

b Install input shaft bearing using special tool.

2）Clutch Driven Disc And Clutch Cover

Using special tool(clutch center guide), install the clutch driven disc and clutch cover (special tool C)；tighten bolt using flywheel holder(special tool A).align disc orientation hole with flywheel orientation pin when installing clutch cover to flywheel. (FIG.11-29)

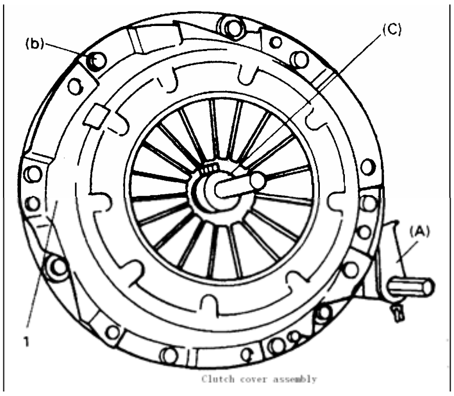


FIG.11-29

3）Clutch Release Bearing

Apply grease to inner surface of （1）(FIG.11-30)

FIG.11-30

4）Clutch Release Fork

Apply grease to release arm end （1）and input shaft end (2) (FIG.11-31)

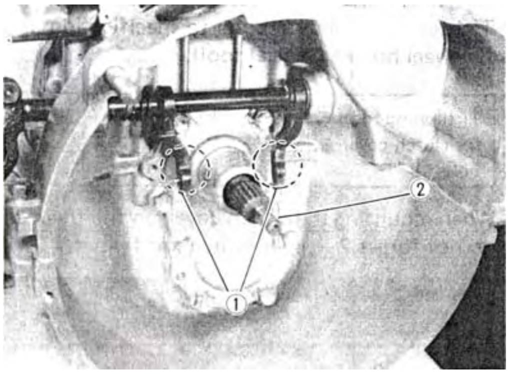


FIG.11-31

5）Clutch Arm

When installation clutch arm, align punch mark 4. (FIG.11-32)

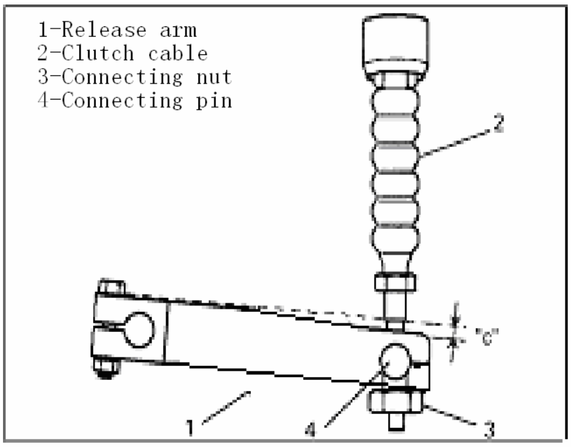


FIG.11-32

6）Clutch Release Shaft Bush

Bush installation refers to correlative section.

12 PROPELLER SHAFT

CAUTION

The propeller shaft should not be welded, dropped or heated intentionally, or possibly some related part will be damaged or the shaft will be eccentric, resulting in the car vibration during driving.

① When part replacement becomes necessary, be sure to use a replacement part of the same part number and do not use a replacement part of inferior quality or substitute design.

② Torque values must be used as specified during reassembly to assure proper retention of these parts.

12.1 GENERAL DISCRIPTION

Propeller shaft consists of propeller shaft weld assembly, spider universal joints, flange yoke and sliding yoke.

The yoke of the front universal joint has its shank internally splined. The splined end of transmission shaft fits into the shank. The outer yoke of the rear joint is fanged; this flange is bolted to the flange, which is splined onto the forward end of the differential pinion.

The cross spider in each universal joint is fitted with four needle roller bearings.（FIG.12-1）

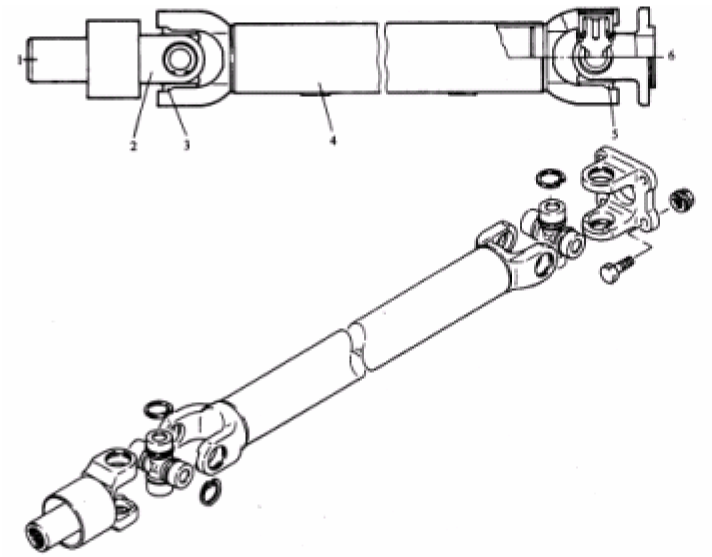


FIG.12-1

1- To transmission main shaft；2-Yoke；3-Front universal joint；4-Propeller shaft；5-Rear universal joint；6-To differential pinion

12.2 REMOVAL

（1） Jack up the vehicle.

（2） Loosen propeller shaft nuts and bolts.（FIG.12-2）。

（3） Remove propeller shaft.

Transmission-side end of propeller shaft has no flange piece, this end is splined to driving shaft inside extension case. All you have to do there is to pull propeller shaft off extension case.（FIG.12-3）

CAUTION

When withdrawing propeller shaft from transmission transmission oil will not leak, provided oil level is to specification and car is raised horizontally in its front and rear direction.

However, if only car front is hoised, be sure to drain transmission oil before withdrawing propeller shaft.

FIG.12-2

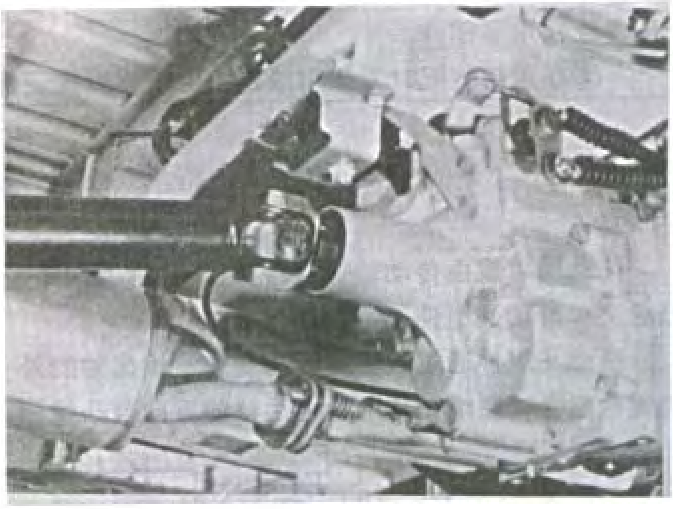


FIG.12-3

12.3 INSTALLATION

Installation procedure is reverse of removal procedure. Be sure to adhere to following instruction when installing shaft:

Torque universal joint flange bolts and nuts to specification.（table12-1、fig.12-4）

Table 12-1

Tightening torque for universal joint flange bolts and nuts	18~28N.m(1.8~2.8kgf.m)

CAUTION

If transmission oil was drained for propeller shaft removal, pour specified gear oil into transmission case to specified level.

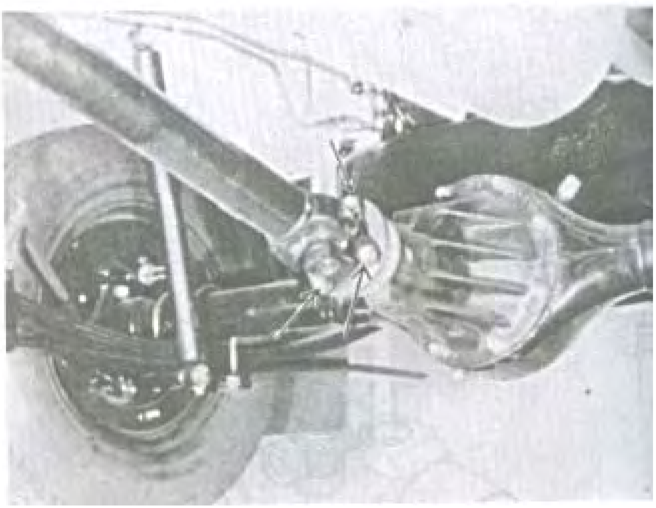


FIG.12-4

12.4 DISASSEMBLY

● Disassembling on propeller shaft yoke side.

（1） Using snap ring pliers(special tool), remove 2 circlips.（FIG.12-5）

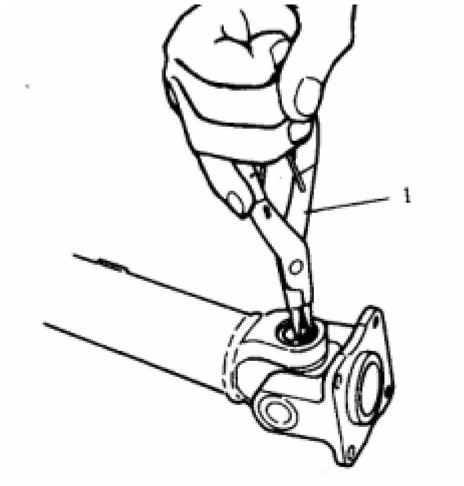
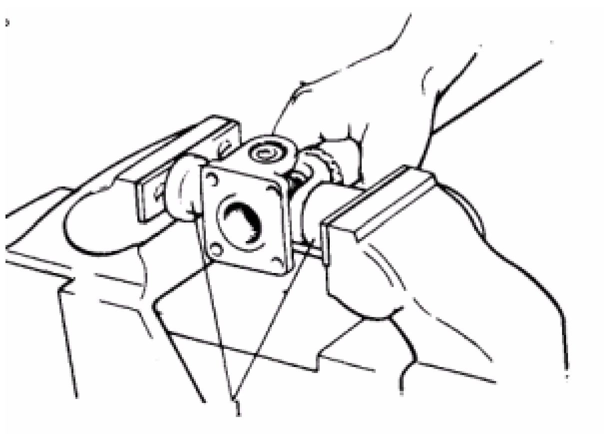


FIG.12-5

1-Special tool(closing type)

（2） Using universal joint assembler(Special tool), push spider bearing race out 3~4mm from shaft yoke race（FIG.12-6,FIG12-7）



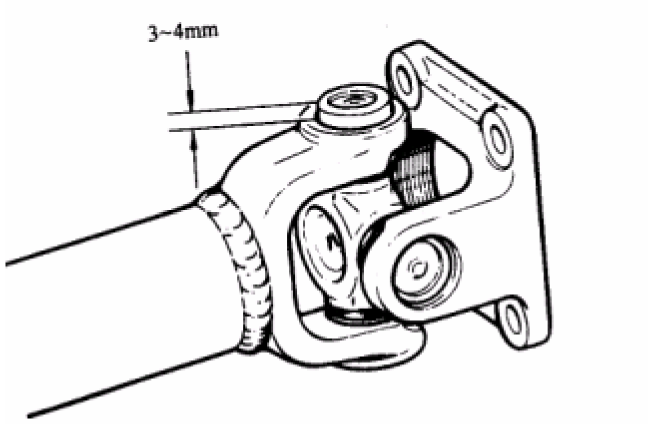


FIG.12-6　　1- Special tool　　　　FIG.12-6

（3） Tapping yoke with a hammer, completely remove bearing race.（FIG.12-8）

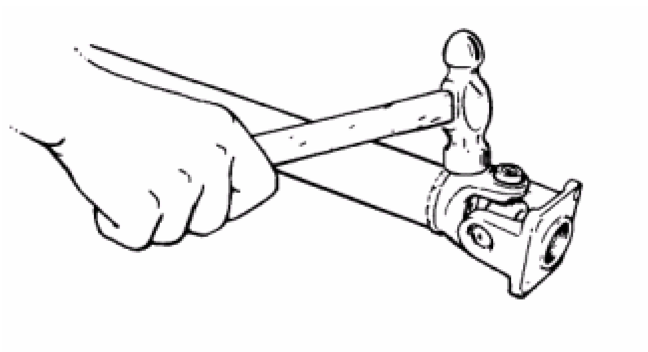


FIG.12-8

（4） Take out bearing race on the other side in the same way as in （2）and (3).

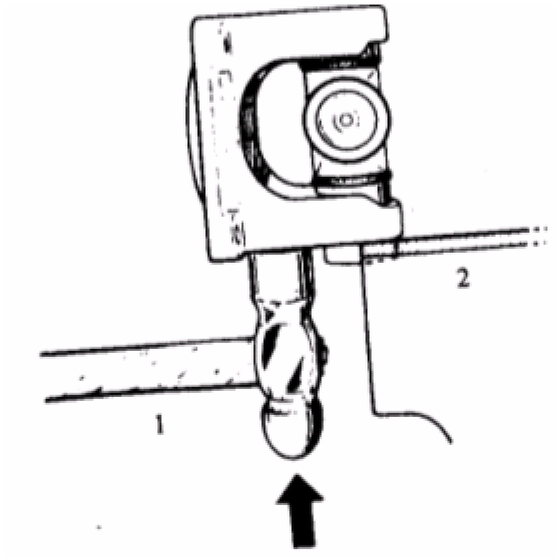
●disassembling on flange yoke side

push out bearing race on flange yoke side as described in （1） and（2），holding bearing race in a vice , tap flange yoke and take out race.（FIG.12-9）; Remove bearing race on the opposite side in the same way.

CAUTION

Take care not to lose rollers in spider bearing race when removing it.

Fit removed bearing temporarily in spider so that they can be reinstalled in their original positions.



1-Hammer;2-Vice

12.5 REASSEMBLY

CAUTION

Make certain that rollers inside spider bearing race are all in place.

Make sure to apply SUPER GREASE （德国福斯 EP-2 GREASE）to spider bearing race（FIG.12-10）

CAUTION

In reassembly, be sure to use new circlips, spider and bearings, Reuse of circlips, spider and bearings once reassembled is prohibited.（FIG.12-11）

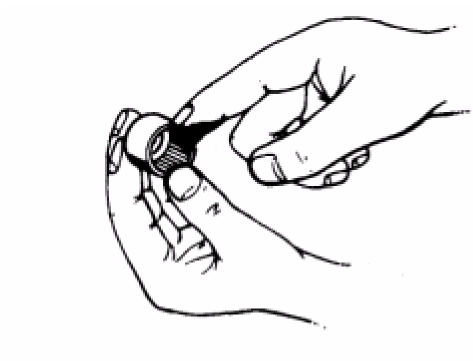


FIG.12-10

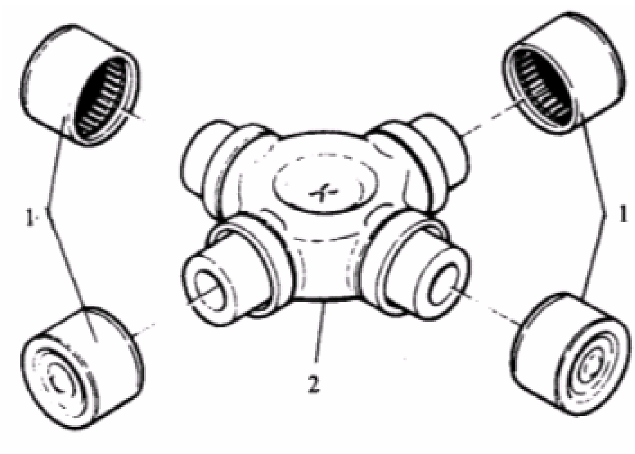


FIG.12-11

1-Bearing ；2-Spider

（1） Insert bearing race into yoke, tapping it with a hammer, until it is flush with yoke face. When doing this, insert spider into bearing race to prevent rollers in bearing race from coming out.(FIG.12-12)

（2） Insert the other bearing race on the opposite side into yoke tapping with a hammer until it is flush with yoke face.

（3） Insert bearing races on the flange yoke side in the same way as described in （1） and（2） above.(FIG.12-13)

（4） Place a metal plate on bearing races when tapping them in to avoid damaging yoke.

（5） Securely fit 4 circlips to shaft and flange yoke.

CAUTION
After reassembly, check to ensure that both shaft yoke and flange yoke move smoothly.

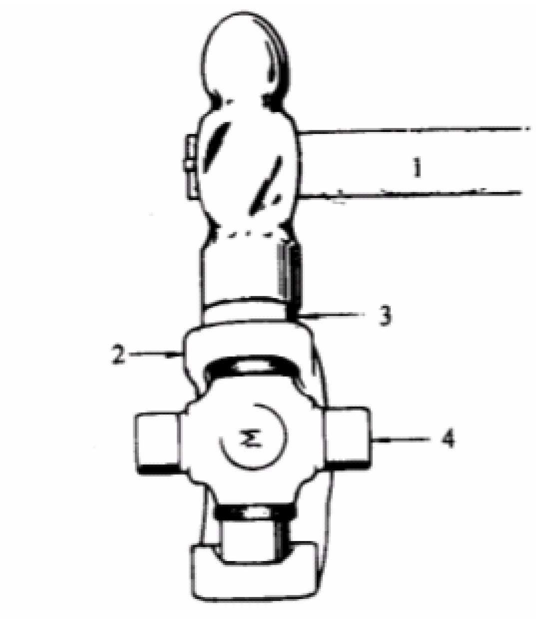


FIG.12-12

1-Hammer;2-Yoke;3-Bearing race;4-Spider

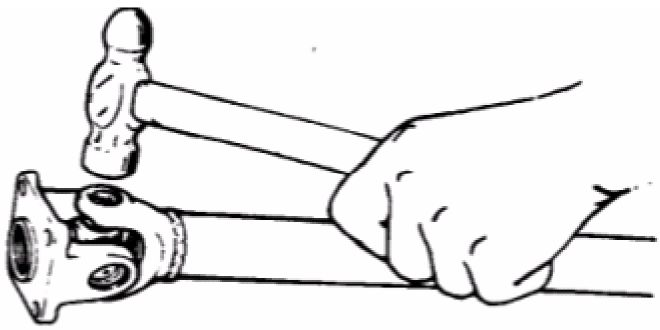


FIG.12-13

12.6 MAINTENANCE SERVICES

●Universal Joint Noise

If universal joints are suspected of producing chattering or rattling noise, inspect them for wear. Check to see if cross spider rattles in yokes or if splints are worn down.（FIG.12-14）

The noise coming from universal joint can be easily distinguished from other noises because rhythm of chattering or rattling is in step with cruising speed. Noise is pronounced particularly on standing start or in coasting condition (when braking effect of engine is showing in the drive line).

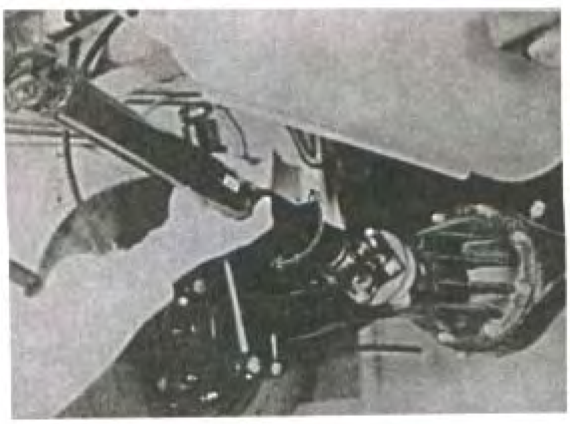


FIG.12-13

12.7 TIGHTENING TORQUE

●Bolts and Nuts

Check following bolts and nuts for tighten and retighten them as necessary. (FIG.12-15)

FIG. 12-15

TABLE 12-2

Propeller shaft bolt and nut	18~28N.m(1.8~2.8kgf.m)

13 REAR AXLE

13.1 GENERAL DISCREPTION

The rear axle is drive type. It consists of reduction final drive, differential, half-axle and rear axle housing. (FIG.13-1)

Rear axles adopt single-stage hypoid bevel gear. The basic function is enlarge propeller shaft torque，and change drive direction. Then transfer to drive wheel. Rear axle can support and transfer gravity, counterforce and torque to ensure wheels two sides change as constant speed, differential speed, forward and backward according to running condition. Half-axle is semi-floating axle shaft. Steel plate through press and weld come into being rear axle case.

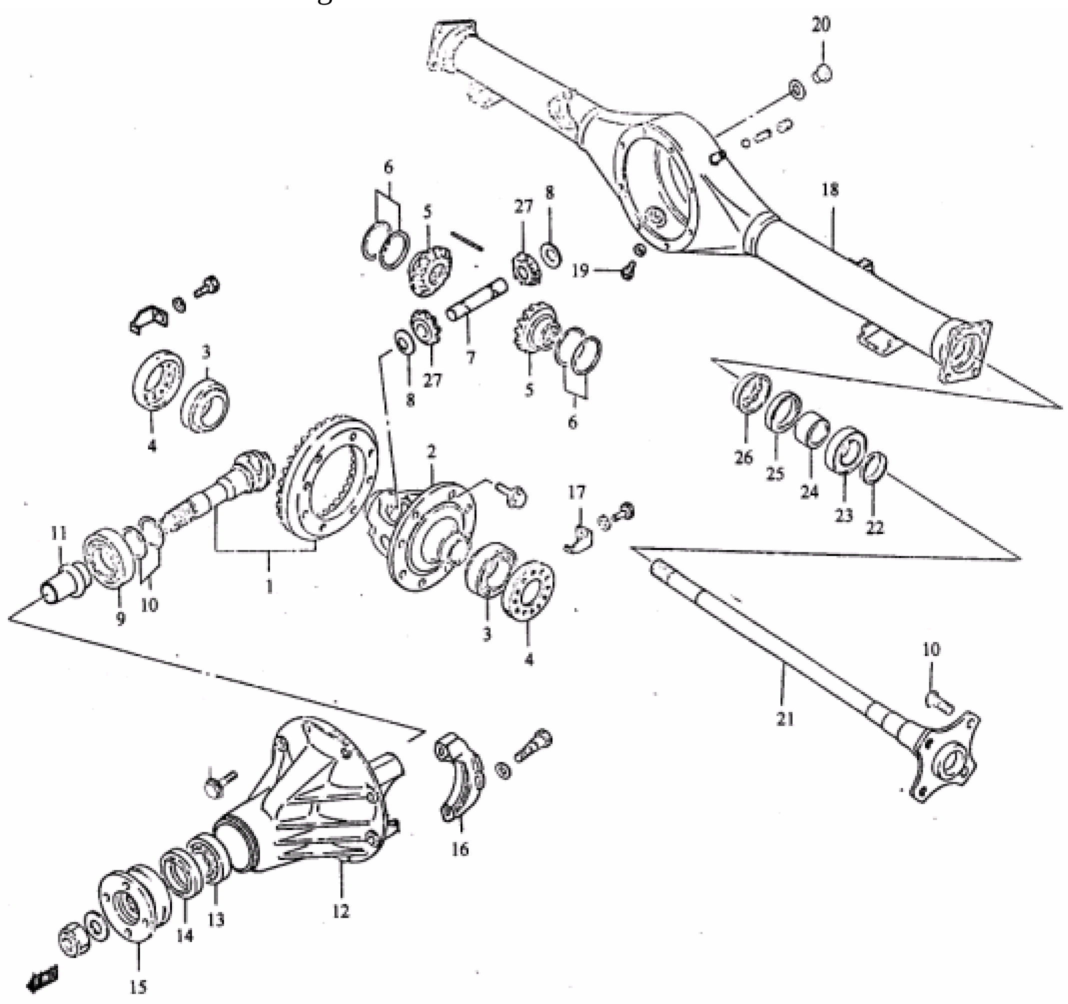


FIG 13-1

1-Drive, driven gear; 2-Diffirential case; 3-Bearing; 4-Bearing adjusting ring;5-Half-axle gear; 6-Thrust washer; 7-Spider gear shaft; 8-Ball washer; 9-Bearing; 10-Adjusting washer; 11-Drive gear bush;12-Reduction final drive case; 13-Bearing; 14-Seal; 15-Universal joint flange;16-Bearing shell;17-Earing disc; 18-Rear axle case 19-Drain plug; 20-Oil filter plug; 21-Half-axle; 22-Half-axle spacer; 23-Bearing; 24-Bearing spacer;25-Seal; 26-Seal bracket; 27-Spider gear

13.2 REMOVAL

CAUTION
After removing, put every components like bearing, gear, washer and seal together to avoid of losing, damage, dirty.

（1）Before removing, park the vehicle on flat road. Stop the engine and pull up the parking brake lever to abstain maximum brake force. Shift gear shift lever in neutral position.

（2）Loosen rear wheel nuts and jack up the rear of the vehicle. Support the rear axle case with stand.

CAUTION

The supporting position of the jack should be secure and the center of gravity should be distributed reasonable. Using pad under the jack if the road is unevenly or soft.

（3）Remove oil drain plug on the bottom of rear axle housing then drain grease into vessel.（FIG.13-2）

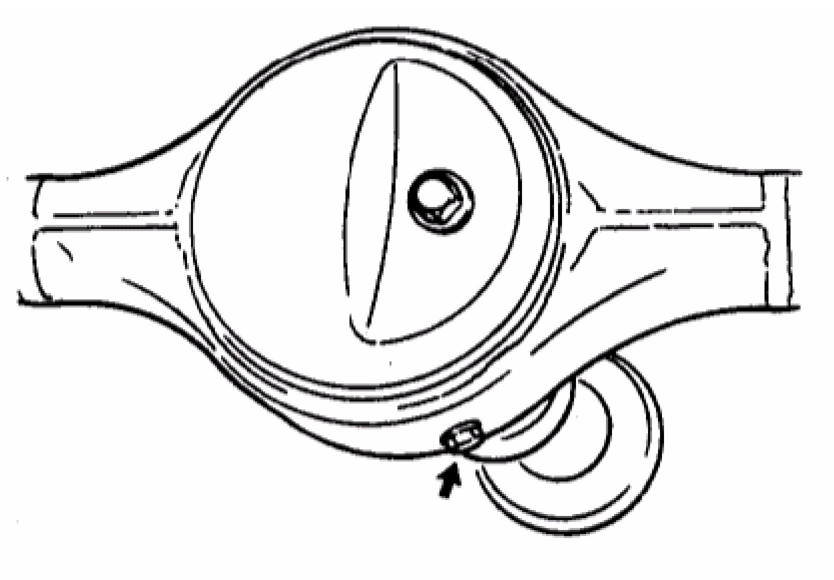


FIG 13-2

（4）Remove four bolts and nuts connecting propeller shaft flange and rear axle flange to release propeller shaft and rear axle.

（5）Remove wheel nuts and wheels.

（6）Install two bolts with proper length into brake drum screw holes and push half-axle out from brake drum.（FIG.13-3）

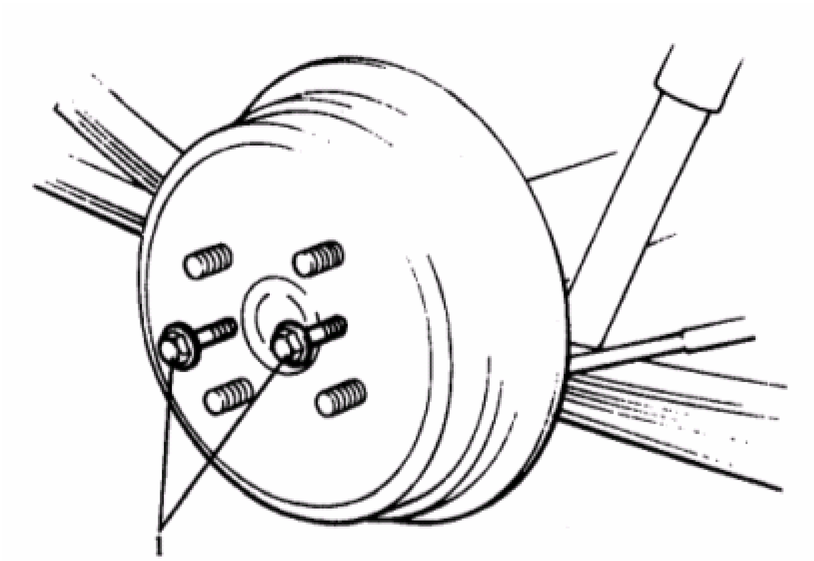


FIG 13-3

1-M8 Bolt

（7）Remove brake shoe spring by rotating brake shoe pin.（FIG.13-4）

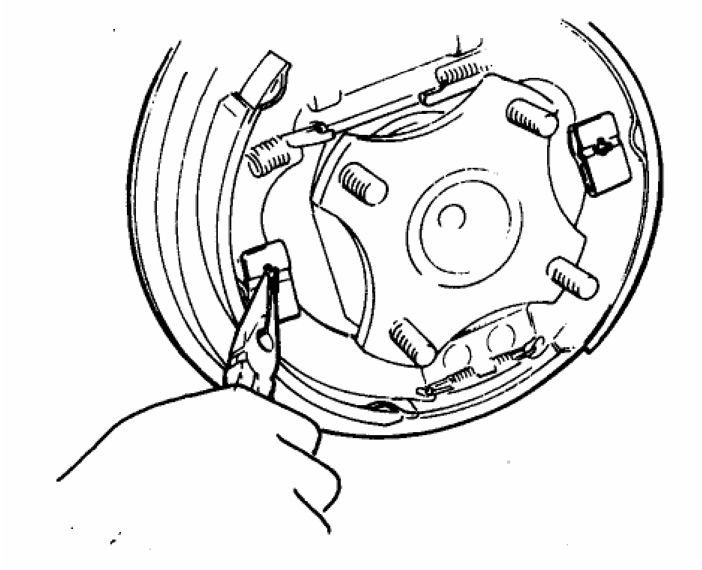


FIG 13-4

（8）Remove paring brake cable from parking brake lever，then remove brake shoe.（13-5）

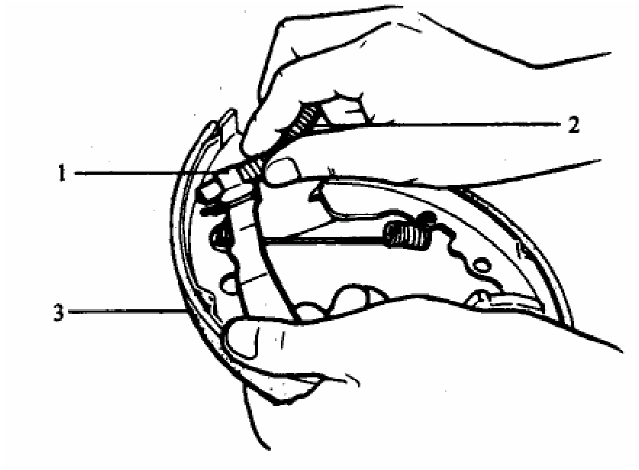


FIG 13-5

1-Paring brake lever; 2-Parking brake cable; 3-Brake shoe

（9）Remove parking brake cable from brake back plate after removing cable clamp.（FIG.13-6）

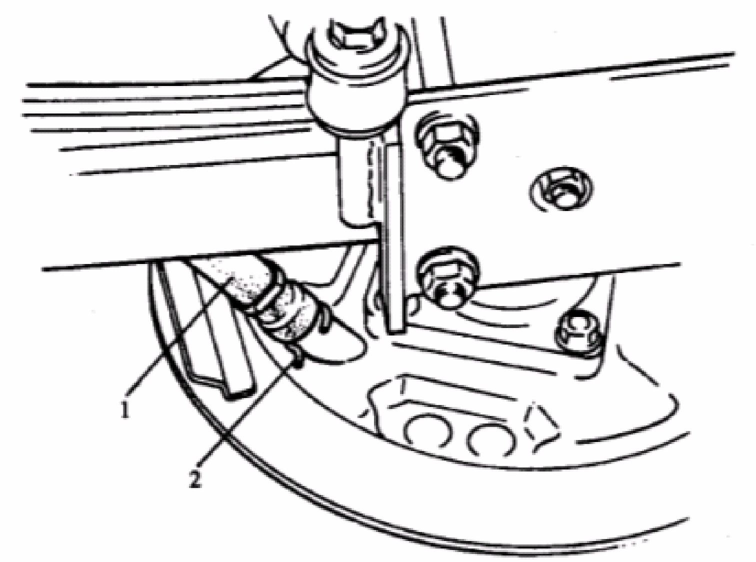


FIG 13-6

1-Paring brake lever; 2-Parking brake cable; 3-Brake shoe

（10）Suck brake fluid from brake reservoir by using injector and disconnect brake pipes and wheel cylinder. Insert rubber plug into pipes to avoid fluid outflow.（FIG.13-7）

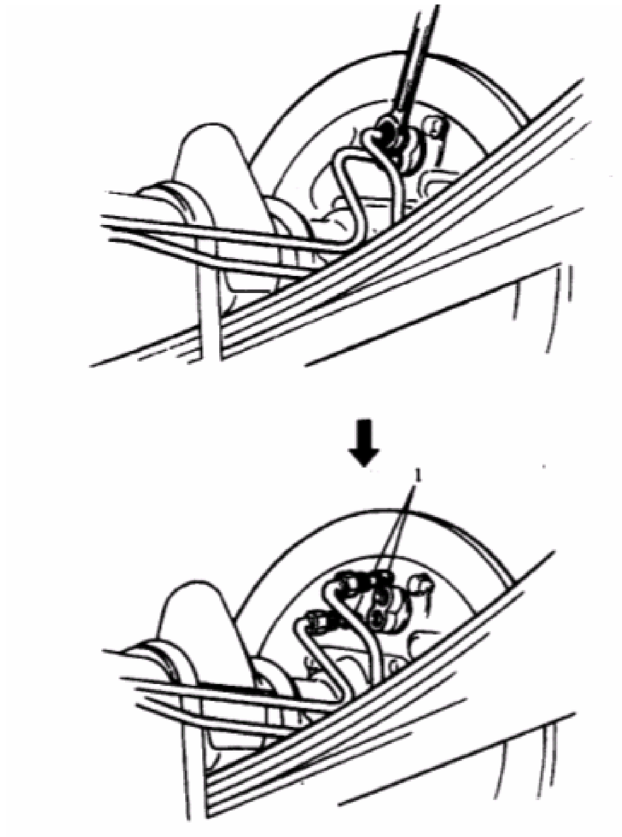


FIG 13-7:1-Rubber plug

（11）Remove four nuts and washers of brake back plate from rear axle housing.（FIG.13-8）

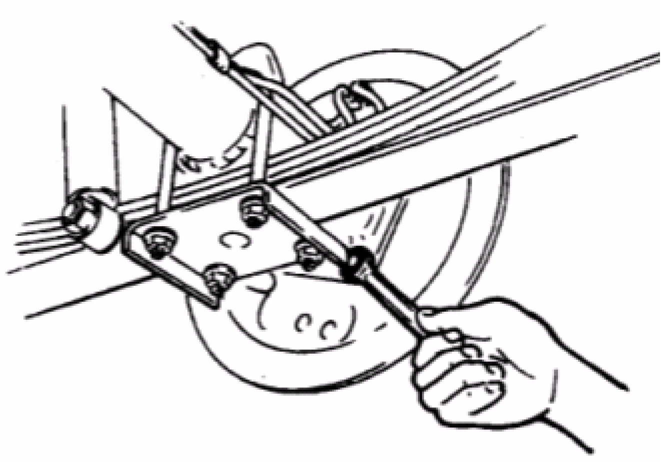


FIG 13-8

（12）Install special tool A(half-axle remover) making use of half-axle bolts. Pull out half-axle assembly by using B (active puller)（13-9）

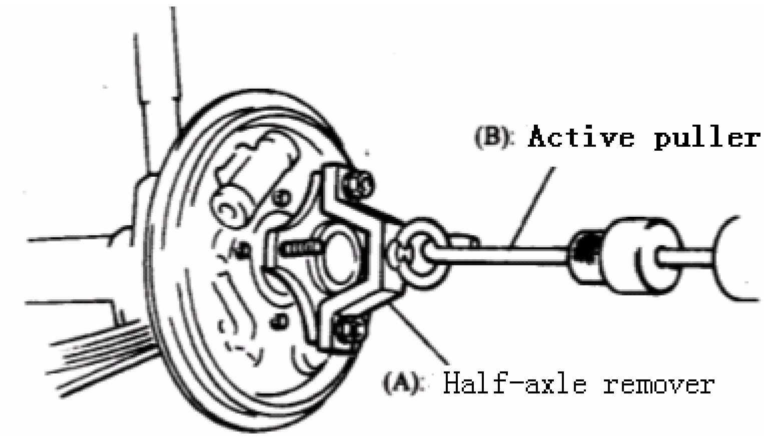


FIG 13-9

（13）After removing eight bolts connecting reduction final drive and rear axle housing, take down reduction final drive assembly.

13.3 REMOVAL AND SERVICE

（1）Half-axle has more high strength. In general, it can not occur more serious problem. After removing, check for bend, crack and deformation mainly. If slightly bend found, revise with pressure machine until the bent is less than 0.8mm. If serious bend or crack found, replace half-axle or half-axle assembly(FIG.13-10）

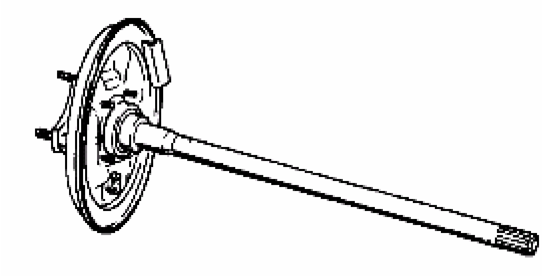


FIG 13-10

（2）Check half-axle bearing for wear. The outer surface of bearing spacer should not be with obvious groove, replace bearing and spacer if necessary. When removing , polish bearing spacer by using grinding wheel until the thick is 1～1.5mm because the match of bearing spacer and half-axle is more tight.(FIG. 13-11)

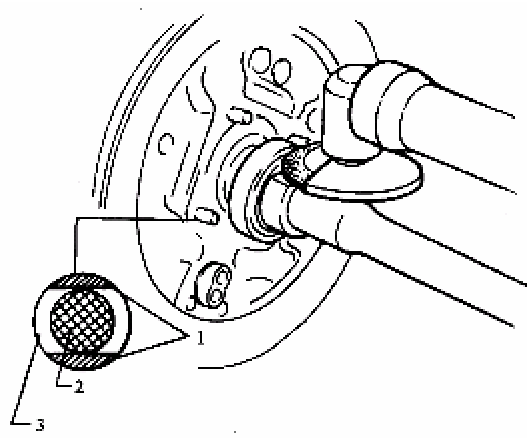


FIG 13-11

1-Thin position polished by grinding wheel; 2-Half-axle; 3-Bearing spacer

（3）Strike thin portion in spacer off by using a chisel. When taking down bearing spacer, pay attention to not to damage half-axle. Take down bearing spacer.（FIG.13-12）

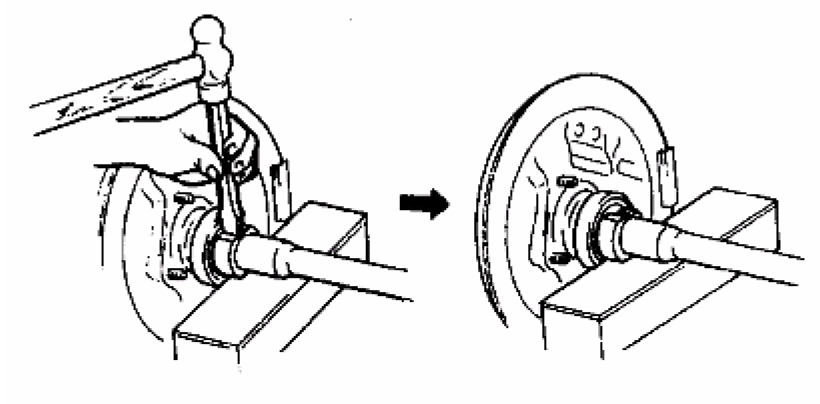


FIG 13-12

（4）After removing bearing and half-axle spacer by using special tools C and D, remove brake back plate（FIG.13-13）

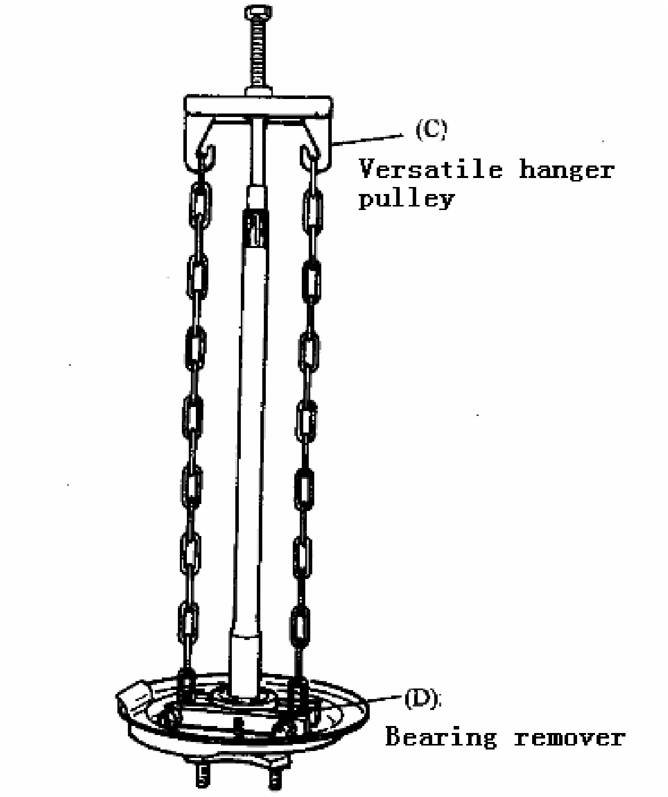


FIG.13-13

（5）Replace whole rear axle housing if bend, deformation or crack on welding line found.

(6) Check half axle seal lip for serious wear, deformation, aging and so on. Replace seal if necessary.

（7）Check vent cover for damage. Replace if necessary.

（8）Install reduction final drive on jig to make universal joint flange not rotating. Loosen drive gear lock nut by using special wrench. If the locked mode of the nut is by pressing, remove it by tool.（FIG.13-14）

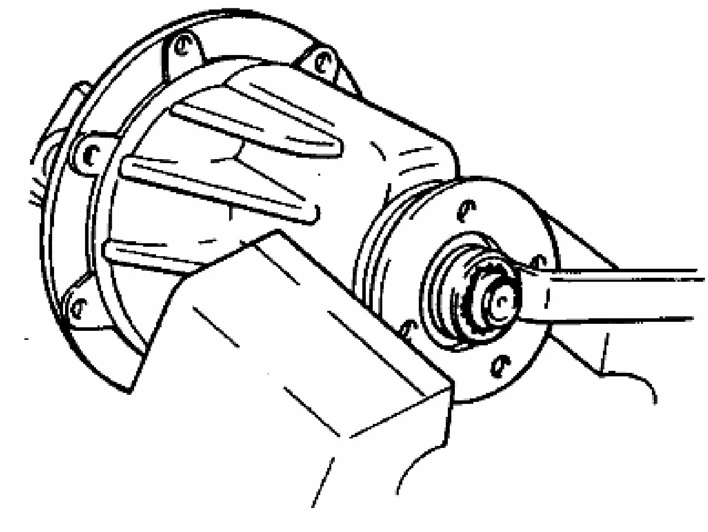


FIG 13-14

（9）Make mark between bearing shell and reduction final drive to avoid wrong installation of left and right bearing shell.

（10）Loosen bearing shell connecting bolt using wrench and take down bearing shell. Remove differential form reduction final drive.

（11）Tap drive gear tail using hammer or copper stick and take out drive gear.

CAUTION:

Take care not to damage drive gear tail screw. Prevent adjusting wash; drive gear bush and seal of drive gear from damage.

（12）Check tooth surface of drive gear and driven gear of differential for crack, flake，deep point and break tooth and so on. If defective found, replacement is necessary.

（13）Pull out drive gear seal. Check seal lip for excessively worn, deformation and aging. If defective is found, replacement is necessary.

（14）Take out drive gear front bearing cone. Tap drive gear front, rear bearing cup by using special tool and check inner, outer track of bearing and roller for excessively wear, burnt. Check to ensure that bearing rotates smoothly and replace as necessary.

（15）Pull out adjusting wash and bearing on the right of differential（FIG.13-15）

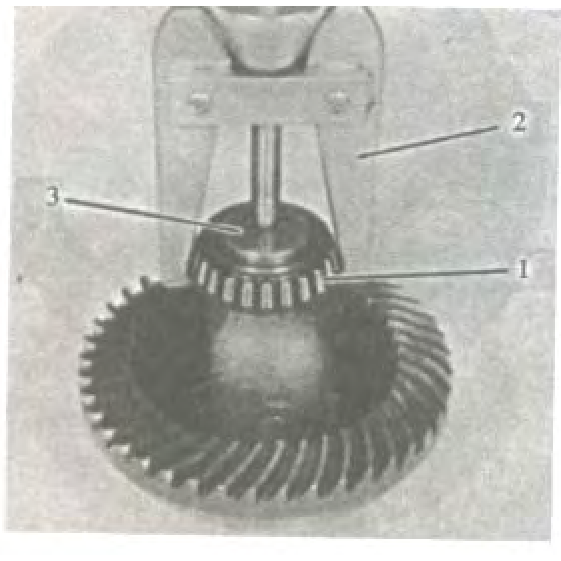
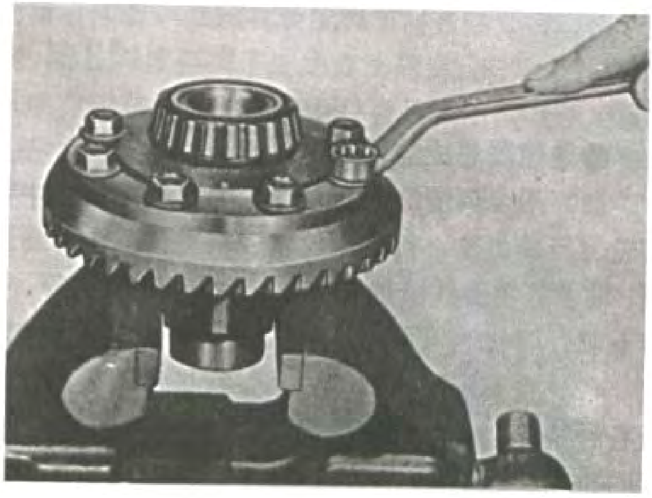


FIG 13-15

1-Right side bearing;2-Bearing puller; 3-Side bearing remover

（16）Loosen eight connecting bolt between driven gear and differential case and take out driven gear.（FIG.13-16）



（17）Pull out adjusting wash and bearing on the left of differential.（FIG.13-17）

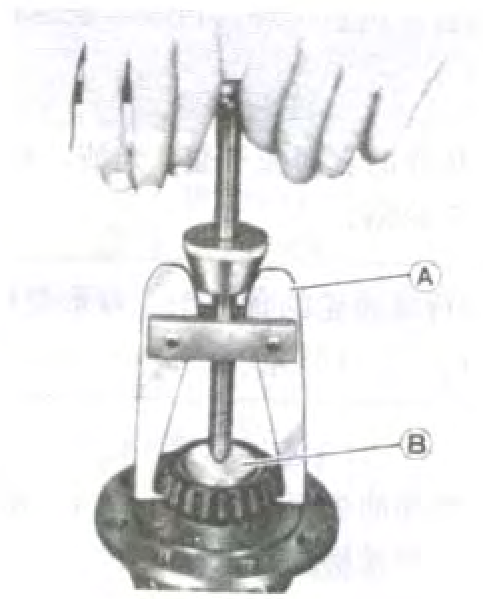


FIG　13-17:1-A-Special tool; B-Bearing

（18）Check inner, outer track of differential bearing and roller for excessively wear, burnt. Check to ensure that bearing rotates smoothly and replace as necessary.

（19）remove spring column pin by using special tool.(FIG.13-18)

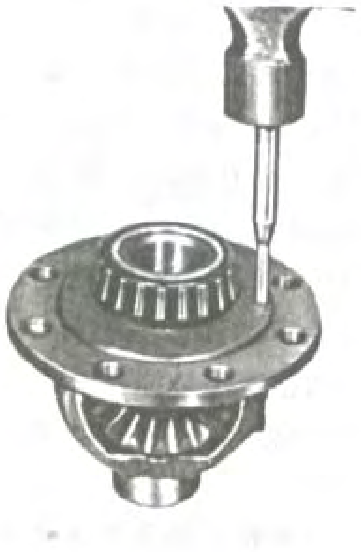


FIG.13-18

（20）After take out spider gear shaft, take out spider gear, ball washer, half-axle gear and half-axle gear adjusting washer.

（21）Check tooth surface of spider gear and half-axle gear for crack, excessive wear or break tooth and so on. If defective is found, replacement is necessary.

（22）Check ball washer and half-axle gear adjusting washer for crack or excessively wear. If defective found, replacement is necessary.

13.4 ASSEMBLY AND ADJUSTEMENT

●Differential Assembly

（1）Wash differential case inner surface, half-axle gear, spider gear, spider gear shaft adjusting washer, ball washer and bearing to be free from dirty and others with metal scour. If burr or hard matter being found, grind them with sandpaper or iron brush.

（2）Apply grease to axle neck of half-axle gear, spider gear rear side, every adjusting washer and meshing surface of differential case.

（3）Install original washers or pre-choosed washers onto half-axle gear axle neck. Then install it into differential case.

CAUTION

Adjusting washer surface should be even, glabrous, without trace, burr and pull.

（4）After fitting ball washer at the back of spider gear, install it into differential case.

CAUTION

Ball washer surface should be even, glabrous, without trace, burr and pull.

（5）After installing spider gear shaft（notice：align pin hole of spider gear shaft with that of differential case），turn half-axle gear or spider gear several circles. Check to ensure that they rotates smoothly without stick or not repeat step (3),（4），（5）.

（6）Put fuse or lead wire or other soft metal wire on mesh position of half-axle gear and spider gear. Turn half-axle gear or spider gear to stave it(FIG.13-19). The staved thickness should be between 0.10~0.20mm. (the thickness is tooth side clearance of half-axle gear and spider gear) If it exceeds limit, remove and rechoose half-axle gear adjusting washer with proper thickness. Repeat steps（3）~（6） until reach standard value.

（1）Clean surface of rear axle housing to mate with reduction final drive and half-axle oil mating surface with metal scour

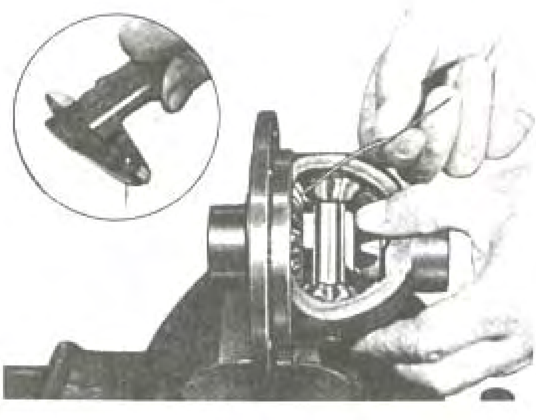


FIG.13-19

（7）After adjusting，install spring pin into pin hole of differential case.

（8）Install driven gear onto differential case. The back surface of driven gear should contact well with differential case end without lean.

（9）Apply screw fastening glue to screw head of driven gear bolt and tighten bolt to specified torque of 65～70N.m. (FIG.13-20)

FIG.13-20

（10）Press-fit differential bearing cone onto axle neck of differential case two end.(FIG. 13-21)

CAUTION

Be sure to press bearing to proper position and without deflection.

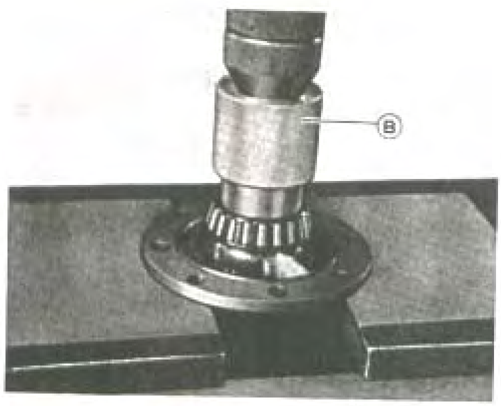


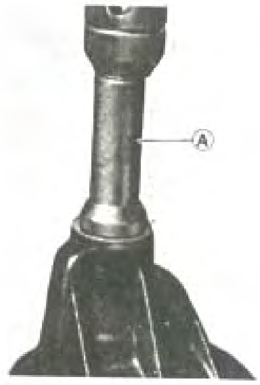
FIG. 13-21

●Reduction Final Drive Assembly

（1）Wash reduction final drive case inner surface, drive gear, driven gear, adjusting washer, bearing and seal to be free from dirty and others with metal scour. If burr or hard matter being found, grind them with sandpaper or iron brush.

（2）When installing two taper roller bearings onto drive gear, be sure to using press. Bearing cup is pressed into bearing saddle bore of reduction final drive case and press bearing cone onto drive gear.

When installing front bearing cup, use special tool A shown in FIG. 13-22. When pressing rear bearing cup, use special tool B shown in FIG.13-23.



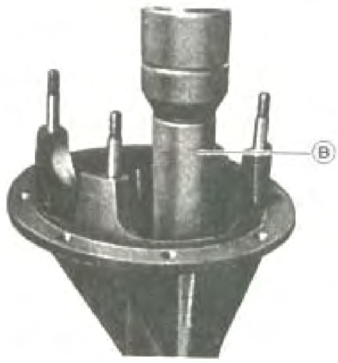


FIG.13-22 FIG.13-23.

（3）Install adjusting washer onto axle neck of drive gear end. The quantity and thickness are different for every vehicle. To ensure proper installation of drive gear and proper meshing clearance between drive and driven gear, make sure to choose proper spacer thickness. Space thickness can be confirmed according to following method. Process a set of drive, driven gear simulation parts for standby. the following explains how to use simulation parts. Make sure to install simulation parts into reduction final case without installing adjusting washer.（FIG.13-24）

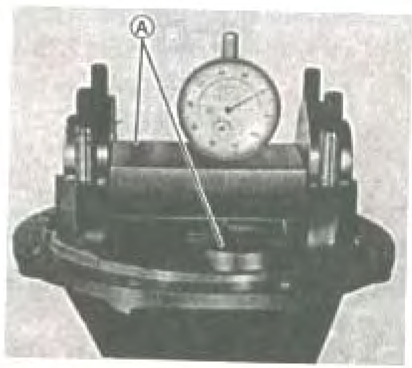
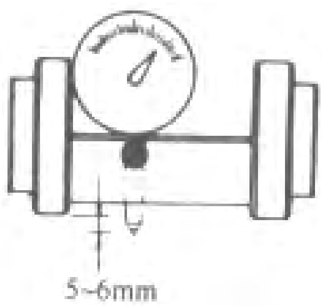


FIG 13-24:A-Drive, driven gear simulation part

a Put micrometer onto simulation part and be sure that the measure stylet protrude simulation part bottom 5~6mm（FIG.13-25）

b Put simulation part on workbench and make micrometer needle point to zero.（FIG.13-26）



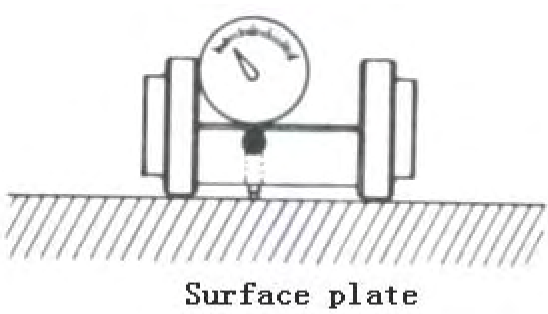


FIG.13-25 FIG.13-26:

c Install drive gear simulation part onto reduction final drive case and install flange. Tighten universal joint flange nut to specified torque of 7N.m（0.7kgf.m）.

d As shown in FIG.13-27，there are three dimensions of “a”、“b”、“c”. The dimension of “b” is unknown. We will calculate adjusting washer thickness as following. “a” plus “c” equal 86 mm.

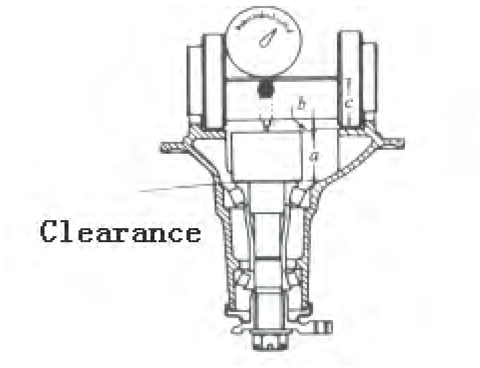


FIG 13-27: Clearance

After installing simulation part, the needle of micrometer will produce excursion. The offset is “b”. “b” plus “a+c” and subtract drive gear demarcated value equal adjusting washer thickness.

Washer thickness needed =（86+“b”）-demarcated value

CAUTION

When choosing adjusting washer, ensure minimum quantity. Adjusting washer surface should be even, glabrous, without trace, burr and pull. Apply grease to adjusting washer before installing.

（4）Press drive pinion gear rear bearing cone by using special stool.(FIG.13-28)

CAUTION:

The bearing should be pressed to proper position steadily without lean.

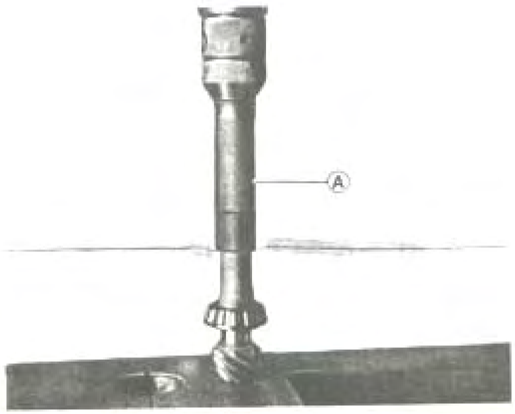


FIG.13-28

（5）Install drive gear to bearing saddle, and install drive gear bush , drive gear pre-force adjusting spacer, front bearing cone, connecting universal joint flange, washer and drive gear lock nut in turn. Before install, apply grease to surfaces of bearing roller and pre-force adjusting washer.

CAUTION

The surface of drive gear pre-force adjusting washer should be even, glabrous, without trace, burr and pull.

Adjusting washer surface should be even, glabrous, without trace, burr and pull.

（6）Tighten drive gear lock nut with special wrench to specified torque of 170～220N.m. Measure gear start torque referring to FIG. 13-29. If torque exceeds standard range(0.392～0.686N.m), remove it. Rechoose adjusting washer with proper thickness. Repeat steps（5）and（6）until abstain right torque.

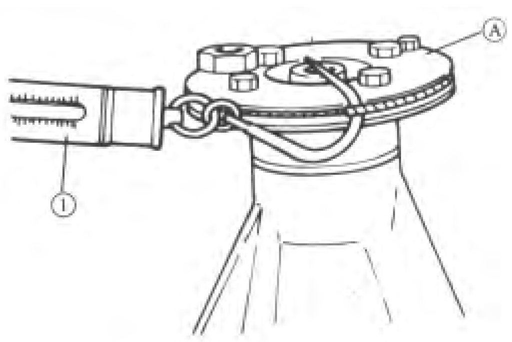


FIG 13-29: 1-Spring balance; A-Pre-force inspection torsion puelly(diameter 100mm)

（7）Remove drive gear. Install drive gear seal into head of reduction final drive case and apply grease to seal lip. If clearance exceeds service limit, replacement is necessary

（8）Install drive gear into gear saddle. Install drive gear bush, drive gear pre-force adjusting washer, front bearing cone, connecting universal joint flange, washer, driver gear lock nut.

（9）Retighten drive gear lock nut to specified torque of 170～220N.m and check gear start torque(FIG.13-29). The torque should be within 0.588～0.882 N.m or not rechoose drive gear pre-force adjusting washer. Repeat step (5)～（9），until abstain right torque.

CAUTION

It is not permitted to decrease gear starting torque by loosening lock nut tightening torque

（10）Install difference and push it to one side(with bearing cup). Measure clearance of bearing saddle and difference bearing cup end. And choose two group of bearing adjusting washer according to half of the clearance measured.

（11）Pull bearing cone on two ends of differential case by using special too. Install differential adjusting washer choosed onto axle neck two ends. Press differential bearing cone .

（12）Apply grease to differential bearing roller and install it into reduction final drive case. Install bearing shell according to mark, and tighten axle shell mounting bolt to specified torque of 34～40N.m.

（13）Measure gear side clearance of drive and driven gear using fuse or other metal.(standard value: 0.1～0.2mm). If the measure value is out of specification, adjust differential bearing adjusting washer.

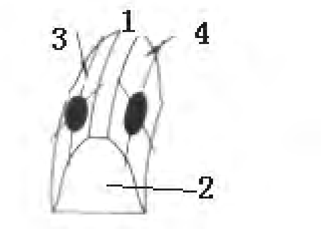
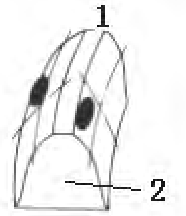
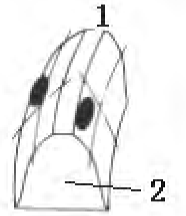
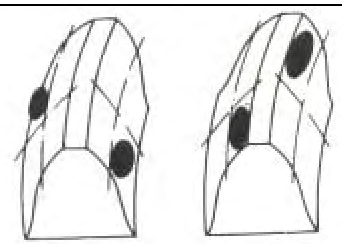
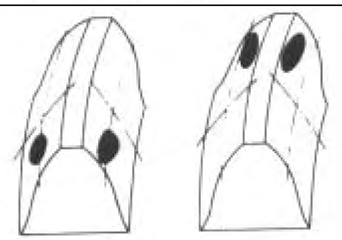
（14）after abstaining specified clearance; apply red diachylon to about ten tooth surfaces of driven gear. When clamping drive gear using “brake” mode, turn gear back and forth to acquire clear contact moulage.

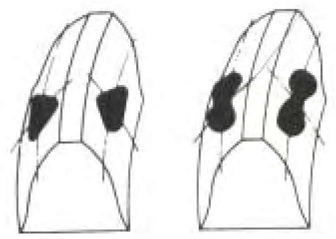
（15）Check red diachylon on driven gear（namely gear mesh moulage section）. Adjust according to FIG.13-30.

CAUTION

After adjusting, wash tooth surface of drive and driven gear by using metal scour.

	Contact type	Judging and disposal

Normal contact	 1- Big end、2-Small end 3 Work side、4-Not working side	On drive side(convexity)and not working side(concave), contact moulage should be at central position leaning to small end. The shape is ellipse as shown in figure.
Contact for not correct washer adjusting	 1-Big end 2- Small end	High contact: drive side contact moulage is at big end and not working end is at small end , which means drive gear is backward. It is necessary to increase adjusting washer thickness to make it forward.
	 1-Big end 2- Small end	Low contact: drive side contact moulage is at samll end and not working end is at big end , which means drive gear is close with driven gear. It is necessary to decrease adjusting washer thickness to make it backward.
Contact for position problem		The contact mode shown in figure means reduction final drive case eccentricity too small or too big, replacement of case is necessary.
		Contact moulage at drive side and not working side are all at big end or small end, which means that: 1. drive, driven gear are defective all. 2. incorrect installation of reduction final drive case. 3. driven gear is wrongly installed onto differential case, replace defective parts.

Contact for position problem		Anomalistic mode: if contact moulage is not ellipse, which means bevel gear is defective. rugged face of tooth or driven gear seat form anomalistic contact moulage. Replace defective parts.

● half-axle assembly

（1）Wash half-axle , half-axle bearing and bearing spacer to be free from dirty and others using metal scour. If burr or hard matter being found, grind them with sandpaper or iron brush.

（2） press rear brake bottom plate, half-axle pacer, half-axle bearing and bearing spacer into half-axle in turn.(FIG.13-31)

CAUTION：

When pressing, inside surface cut aslant of half-axle bearing spacer should face brake drum. When pressing half-axle spacer, take care of outer surface not to be damaged or not damage spacer will wear seal to result in oil leakage.

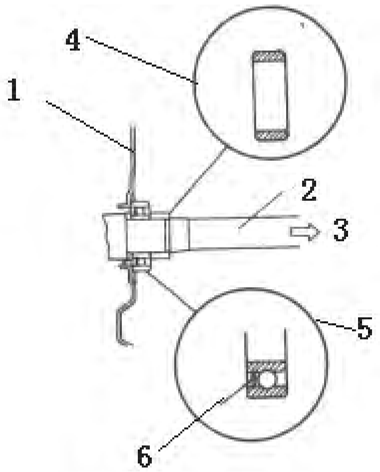


FIG 13-31

1-Brake back plate; 2-Half-axle;3-Differential side; 4-Bearing spacer； 5-Bearing 6-Sealant side

（3）Press-fit half-axle bearing and bearing spacer to specified position using press.

CAUTION

When pressing, ensure to be stable. Half-axle bearing should be located. Peripheral surface of bearing spacer should contact well with half-axle bearing.

（4）Apply grease to half-axle bearing and bearing spacer.

●Rear axle assembly

（2）Clean surface of rear axle housing to mate with reduction final drive and half-axle oil mating surface with metal scour

（2）Install reduction final drive into rear axle housing. Before installing, apply half-dry sealant to rear axle housing mounting face.

（3）Install connecting nut and washer of reduction final drive and rear axle housing, and tighten to specified torque:25～30N.m

（4）Connect propeller shaft flange fork and flange plate and tighten to specified torque:18～28N.m.

（5）Apply screw thread fastening glue to oil drain plug mounting face and washer face and tighten oil drain plug to specified torque: 50～70N.m

CAUTION
Before apply sealant, check oil drain plug surface and washer for burr or splash. If defective found, wipe off sandpaper or file. Replace if serious deformation or scar found.

（6）Loosen oil filler plug and take out plug and plug washer.

（7）Apply staunch sealant to surface of rear axle to mate with brake back plate.(FIG.13-32)

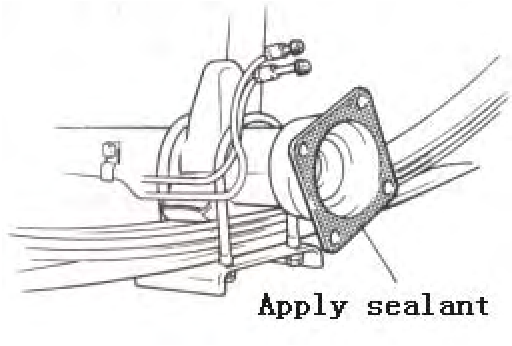


FIG 13-32

（8）Install half-axle into rear axle housing and tighten brake back plate bolt to specified torque.(FIG.13-33)

CAUTION
1、When installing half-axle into rear axle housing, be sure not to damage half-axle oil seal lip. 2、Before installing, check half-axle seal for proper installation . Apply grease to half-axle seal lip before installing half-axle assembly.

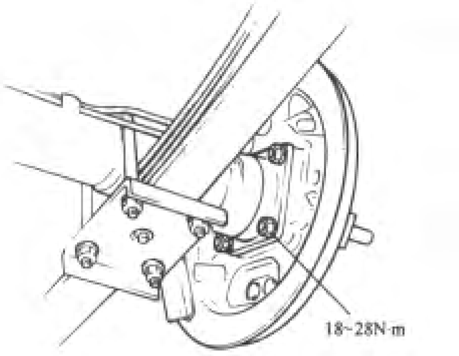


FIG.13-33

（9）Apply sealant to surface of parking brake cable to mate with brake back plate. After install brake cable through brake back plate, fix it with clamp.（FIG.13-34）

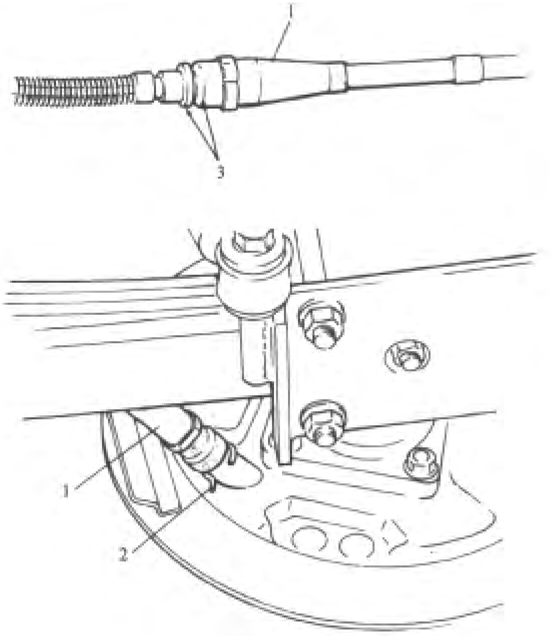


FIG 13-34：1-brake cable;2-applying sealant

（10）Remove air bleed plug cap and connect brake pipe to wheel cylinder. Tighten nut to specified torque:14～18N.m（FIG.13-35）

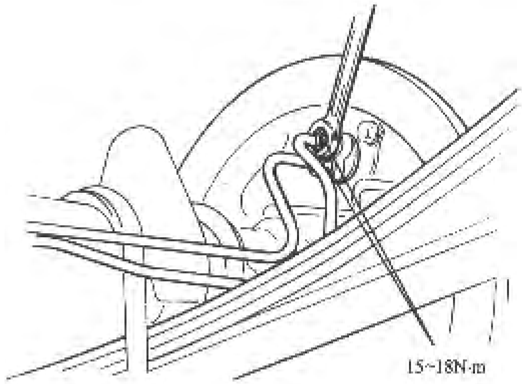


FIG.13-35

（11）Connect brake cable and parking brake lever, then install brake shoe. Pay attention not to damage cable cover.（FIG.13-36）

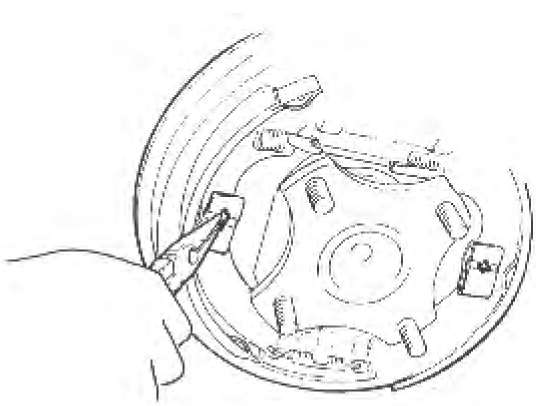


FIG.13-36

（12）Before installing brake drum, insert screwdriver between anchor plate and click pulley so as to augment the clearance between shoe and drum. The clearance shown in FIG. 13-37 is maximum.

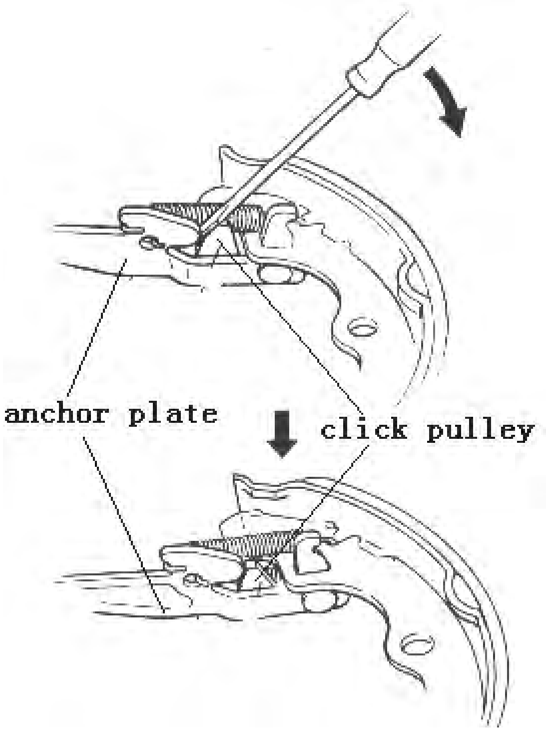


FIG. 13-37

（13）Fill 1.3 liter GL-5 80W-90 hypoid oil from oil filter hole or fill until oil overflowing from oil filter hole. Tighten oil filter plug to specified torque: 40～65N.m

（14）Install wheels and tighten wheel nuts to specified torque: 80～90N.m

（15）Refill brake lines with brake fluid and bleed air. Depress brake pedal with the force of 200～300N to adjust the clearance between brake drum and shoe.

（16）After checking brake drum and brake system for normal working, put down body from stand. Check brake performance.

（17）Recheck every connect position for fluid or oil leakage.

14 SUSPENSION

CAUTION

All the tightening parts for suspension are very important, when replacing, using the part with same part number or same strength is necessary. Be sure to tighten them to specified torque after replacing.

Do not try to repair parts with the method of heating , quenching or alignment，replace new part if necessary .

14.1 GENERAL DESCRIPTION

The front suspension is a Mcpherson strut with coil spring; it consists of strut assembly, stabilizer bar, tension bar, lower arm and steering knuckle. (FIG.14-1)

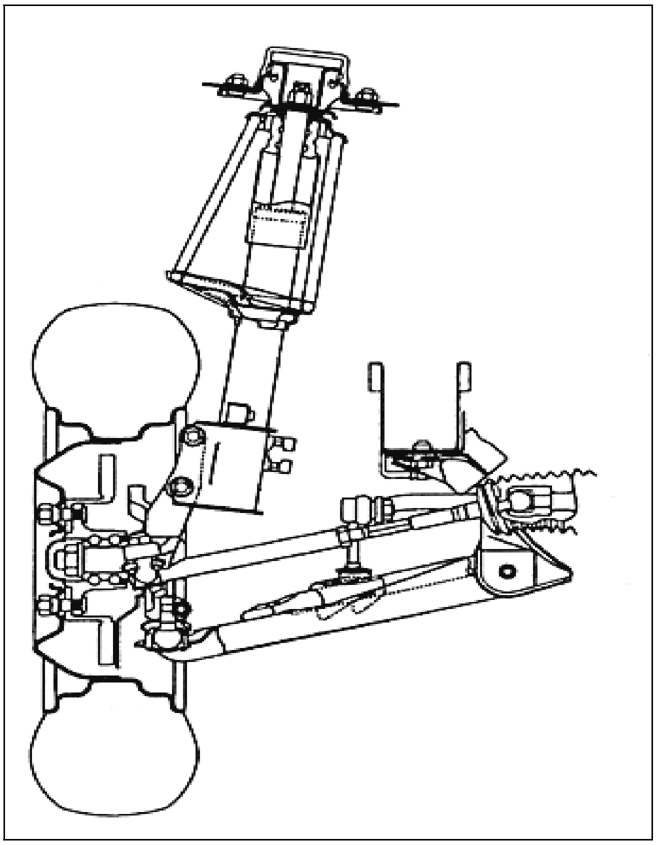
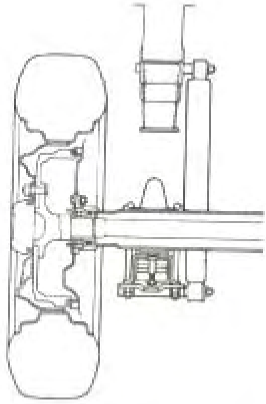


FIG.14-1

The rear suspension is leaf spring dependent type; it consists of rear leaf spring, bump stopper and rear absorber. (FIG.14-2).



14.2 FRONT SUSPENSION

Front suspension construction diagram is shown in FIG.14-3 .

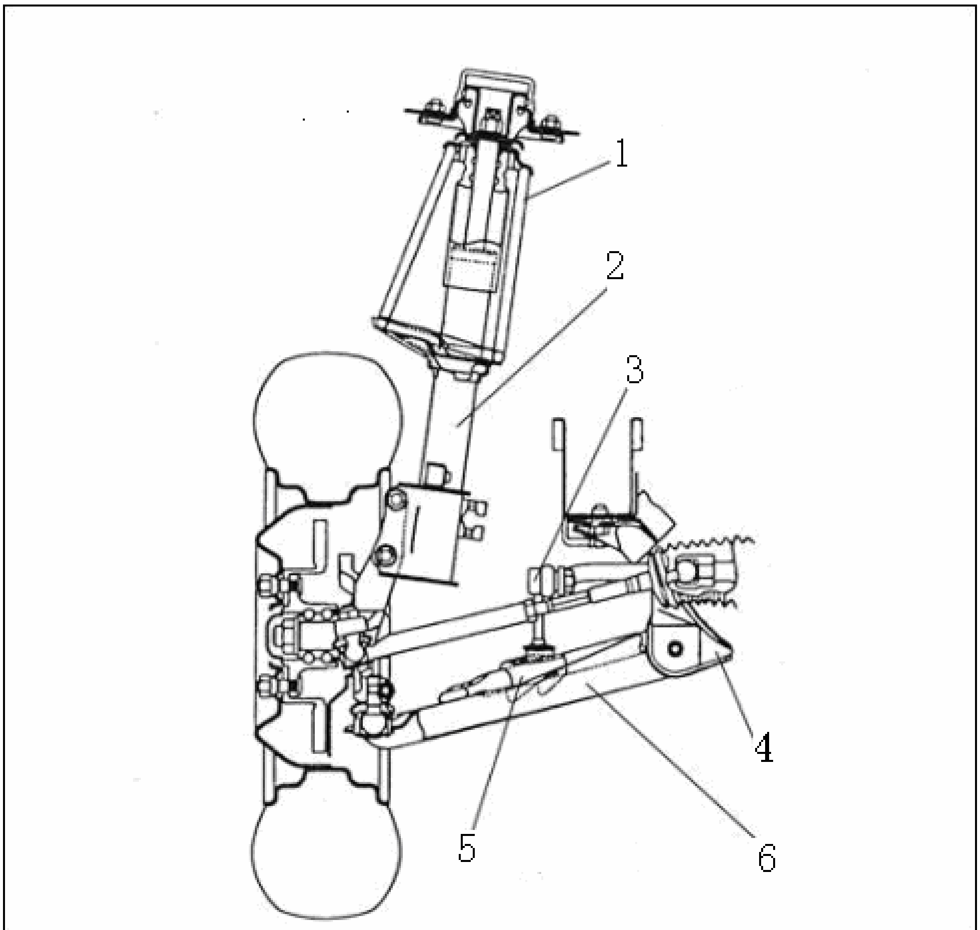


FIG.14-3

1： Front coil spring；2： Front strut 3： Front stabilizer and link；

4：Crossmember ；5： Tension rod ；6： Lower arm

1 FRONT STABILIZER BAR (FIG.14-4)

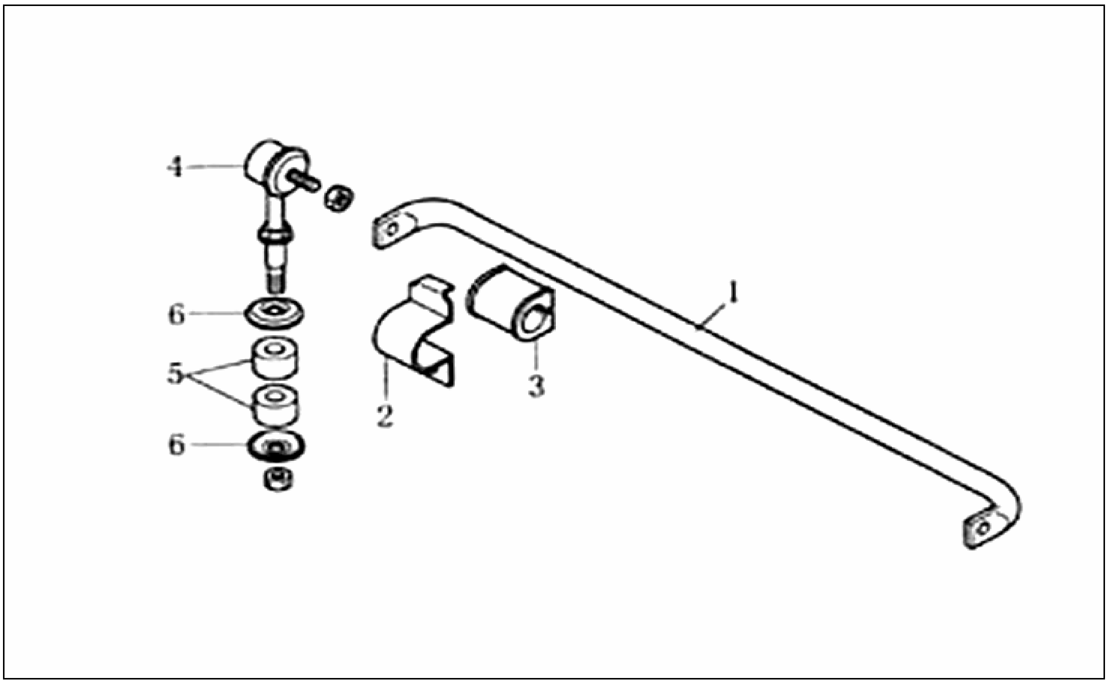
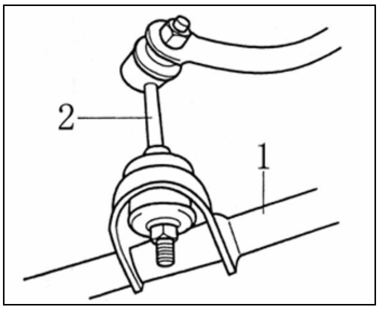


FIG.14-4

1-Front stabilizer bar; 2-Bracket;3-Bush;4-Stabilizer link ;5-Bush;6-Washer



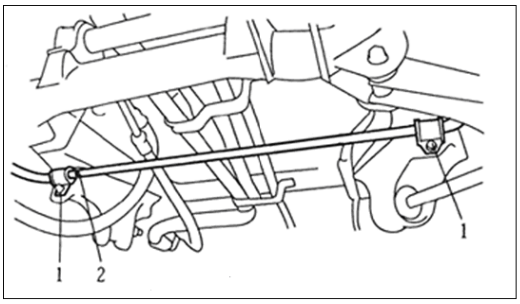
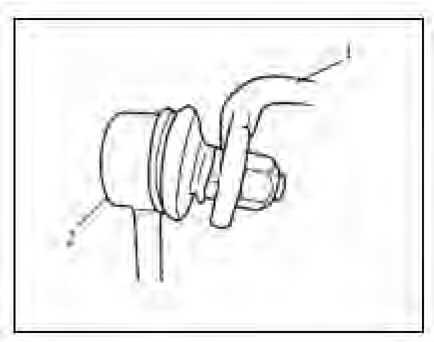


FIG.14-5

FIG.14-6

1-Bolt; 2-Front stabilizer bar bracket mounting mark



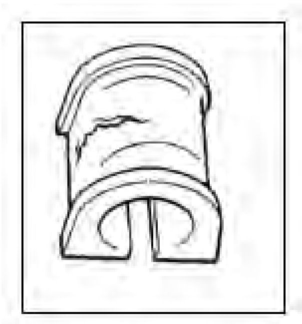


FIG.14-7

1- Front stabilizer bar;2- Front stabilizer link

FIG.14-8

Bush

1） Removal steps

（1） Lift up the vehicle.

（2） Remove stabilizer link from tension rod. (FIG.14-5)

（3） Remove flange bolt and bracket. (FIG.14-6)

（4） Remove stabilizer link from front stabilizer bar (FIG.14-7).

2） Inspection and service

（1） Check front stabilizer bar and bracket for damage and distortion; replace them if necessary.(FIG.14-4)

（2） Check bush for cracks or aging; replace them if necessary.(FIG.14-8).

3） Installation

（1） It is the reverse of removal procedures. Tighten bolts or nuts to specified torque.。

CAUTION

The mounting position of stabilizer bar bush can refer to FIG.14-6; align the stabilizer bar identification mark with the left end of the bush.

（2）The specified torque can refer to TABLE14-1，the position can refer to FIG.14-5~FIG.14-7

Tightening parts	Tightening torque value（N.m）
Stabilizer bar and stabilizer link	40~60
Stabilizer bar bracket and tension bar bracket	23~30
Stabilizer link and tension bar	18~28

2 STRUT ASSEMBLY (FIG.14-9)

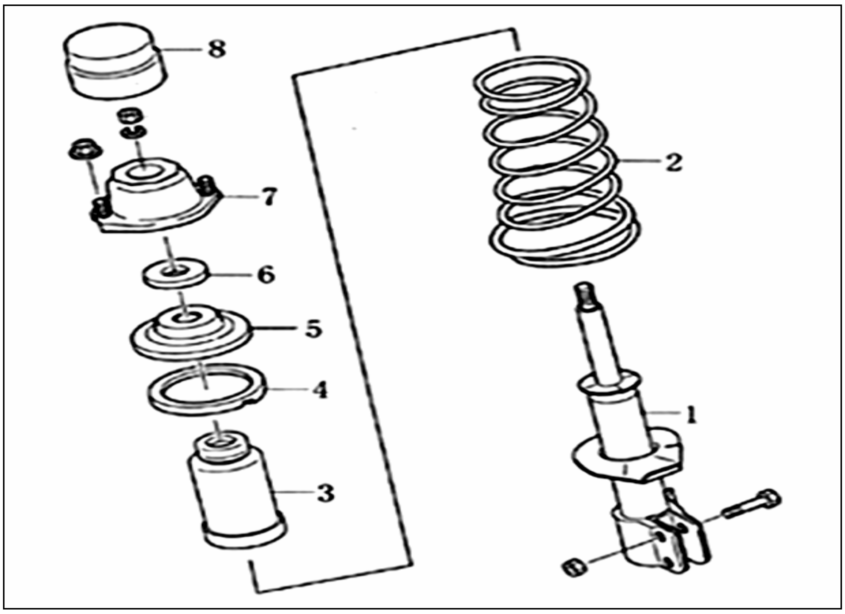


FIG.14-9

1. Strut assembly
2. Coil spring
3. Bump rubber
4. Upper spring pad
5. Upper spring seat
6. Bearing
7. Strut insulator assembly
8. Dust cove

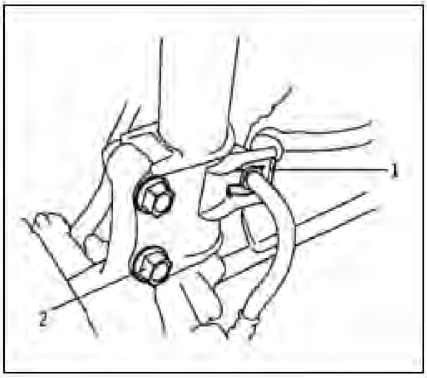


FIG.14-10

1-“E” ring; 2-Flange nut

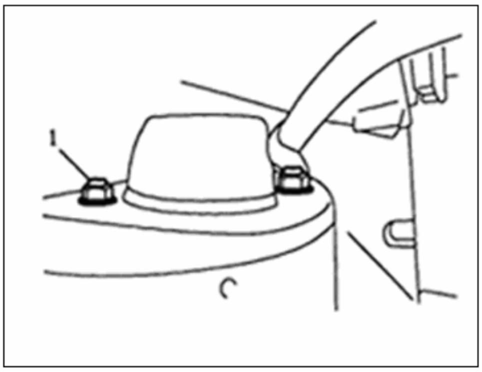


FIG.14-11

1.Flange nut

1) Removal steps

（1） Lift the car.

（2） Removal front wheels. (Refer to front wheel removal)

（3） Removal “E” ring which fixes the brake hose, and removal brake hose from hose bracket (FIG.14-10)

（4） Removal flange nut. (FIG.14-10).

（5） Removal wheel speed sensor bolt

（6） Removal strut top mounting nut (FIG.14-11).

CAUTION
Be care not to damage brake hose and wheel speed sensor.

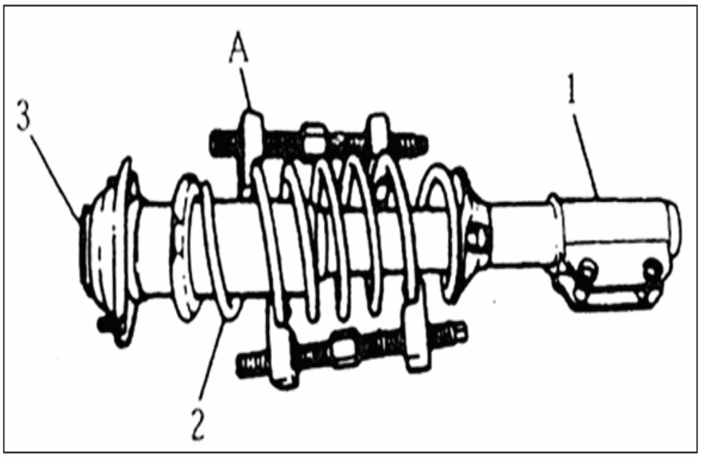


FIG.14-12

1-Struct assembly; 2-Coil spring; 3-Nut

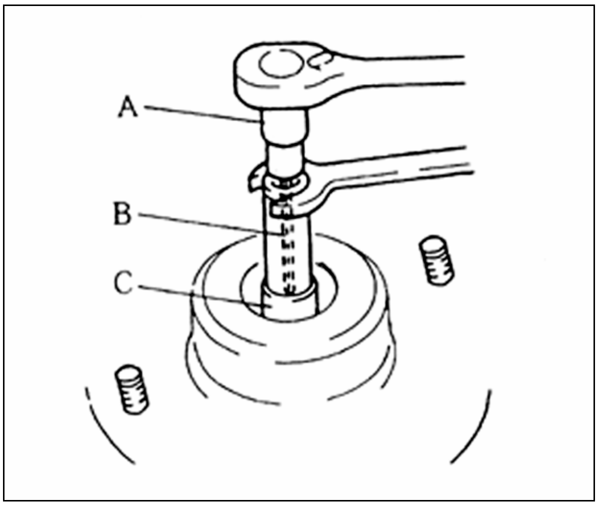


FIG .14-13

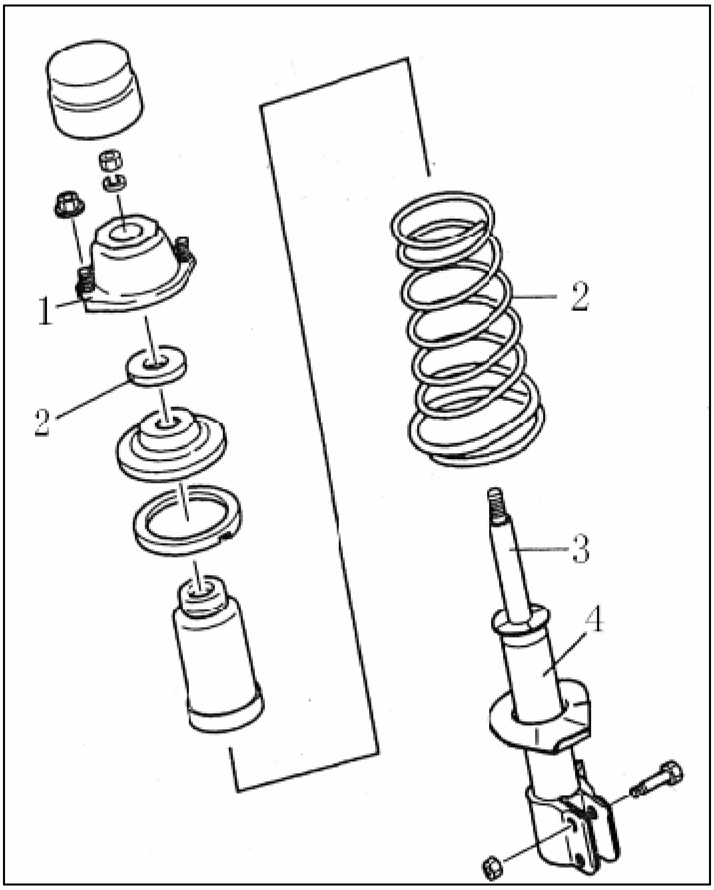


FIG.14-14

1：Deformation； 2：Damage 3：Bent 4：Oil Leakage

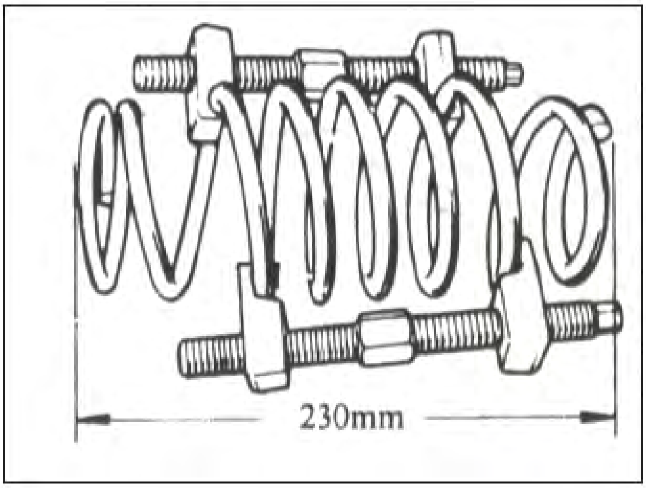


FIG.14-15

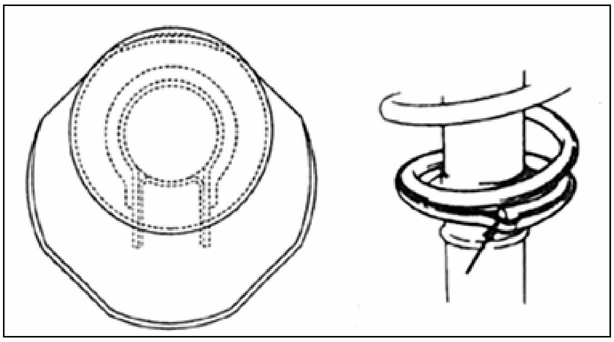


FIG.14-16

2) Disassembly

(1) Use the special tool (A) to compress the coil spring until the strut assembly can rotates slightly (FIG.14-12).

(2) Loosen the self-locking nut by using the special tool (A), (B), (C)(FIG.14-13), disassembly the part according to FIG.14-9.

3) Inspection

Refer to FIG.14-14

（1） Check rubber parts for crack, aging, replace if necessary.

（2） Check strut insulator assembly and bearing for distortion and damage, replace if necessary.

(3) Check coil spring for crack, distortion, replace if necessary.

(4) Check piston rod of strut assembly for bend and distortion, and check tube for leakage replace if necessary.

4) Assembly

（1） Compress coil spring to approx.230mm high.

（2） Align the end of coil spring with the groove in the lower spring seat (FIG.14-16).

（3） Assembly the parts referring to FIG.14-9.

（4） Using the special tools, tighten nut to the specified torque. (FIG.14-13)Tighten torque:50~70N.m.

（5） Unscrew and remove coil spring special tools (A), when unscrewing the special tools, recheck if the end of coil spring fits well with the spring seat.

CAUTION

1. Ensure the coil spring is compressed fully when installing.
2. Installing lower spring seat and knuckle bracket according to FIG.14-16.
3. Ensure aligning the end of the coil spring with the groove in the spring sear.

5) Installation

（1） It is the reverse of removal procedures. Tighten to the specified torque.

（2） The tightening torque can refer to Table 14-2，the position can refer to FIG.14-10~FIG.14-11.

TABLE14-2

Tightening parts	Tightening torque value（N.m）
Strut upper mounting nut	65~85
Knuckle connection nut	80~110

（3）Wheel installation can refer to wheel group.

3 TENSION ROD AND LOWER ARM. (FIG.14-17)

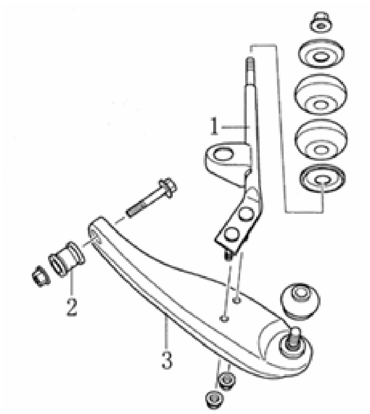


FIG.14-17

1、Tension bar 2、Rubber bush 3、Lower arm

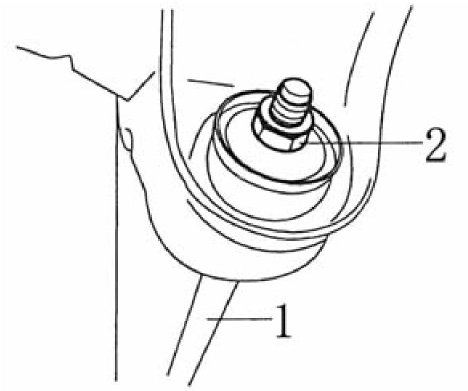


FIG.14-18

1、 Tension bar 2、 Locking nut

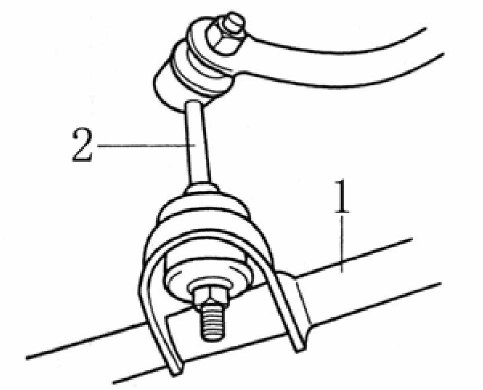


FIG.14-19

1、 Tension bar 2、 Stabilizer link

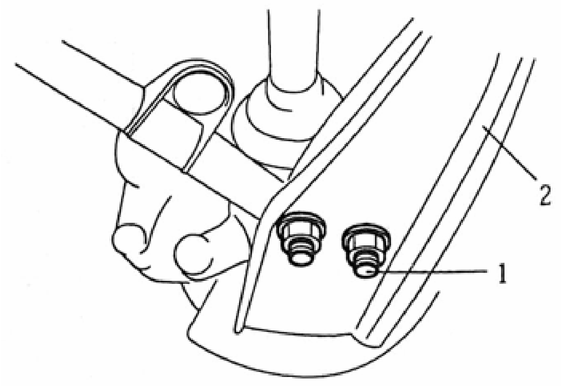


FIG.14-20

1-Tension bar mounting bolt;2-Lower arm

1）Removal steps

（1） Lift the vehicle, and then remove the wheel.

（2） Remove the nut connecting tension bar and bracket (FIG.14-18).

（3） Remove the nut connecting tension bar and stabilizer link (FIG.14-19).

（4） Remove the nut connecting tension bar and lower arm (FIG.14-20).

（5） Remove the nut connecting lower arm and crossmember (FIG.14-21).

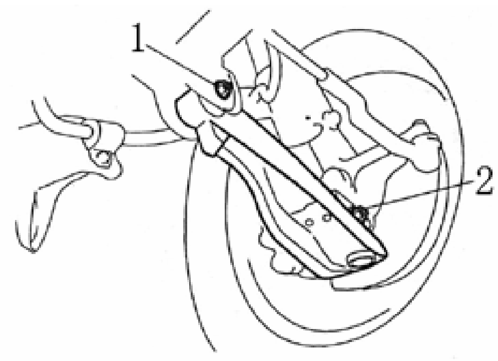


FIG.14-21

1-Lower arm and crossmember mounting bolt;2-Lower arm and knuckle mounting bolt

（6） Remove the nut connecting lower arm and knuckle (FIG.14-21).

2）Disassembly

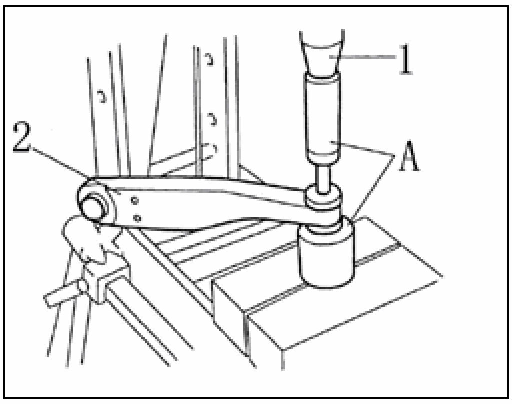


FIG.14-22

1-Special tool;2-Lower arm

Disassemble the rubber bush by using specified tool (A) (FIG.14-22)

3) Inspection

（1） Check rubber parts of tension bar for damage or cracks, replace if necessary.

（2） Check tension bar for damage , replace if necessary.

（3） Check screw on the ball joint stud for damage and check the dust cover for cracks, replace if necessary. (FIG.14-23)

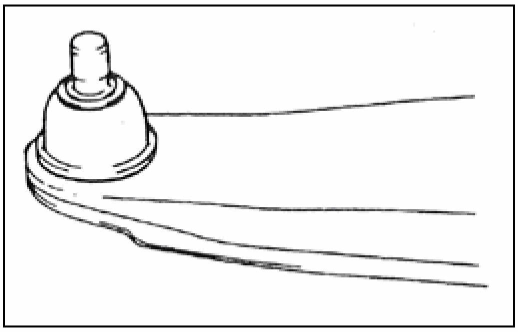


FIG.14-23

（4） Check rotation torque of ball joint. Standard value :0. 49~3.43N.m.

CAUTION
It is not allowed to disassemble ball joint. Replace lower arm assembly if there is troubleshooting like (3), (4).

4）Assembly

（1） Compress bushing by using specified tool (A) (FIG.14-22).

（2） Compress bushing until the protruding length on two sides of arm is equal. (FIG.14-24).

CAUTION
Be sure to replace new bush assembly.

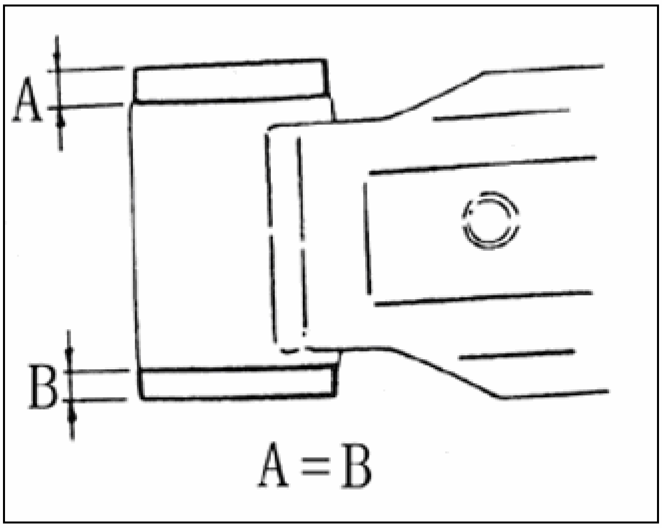


FIG.14-24

5) Installation

（1） Install lower arm to crossmember (FIG.14-25). Tighten lower arm nut to specified torque when the lower arm angle is as shown in FIG.14-25.

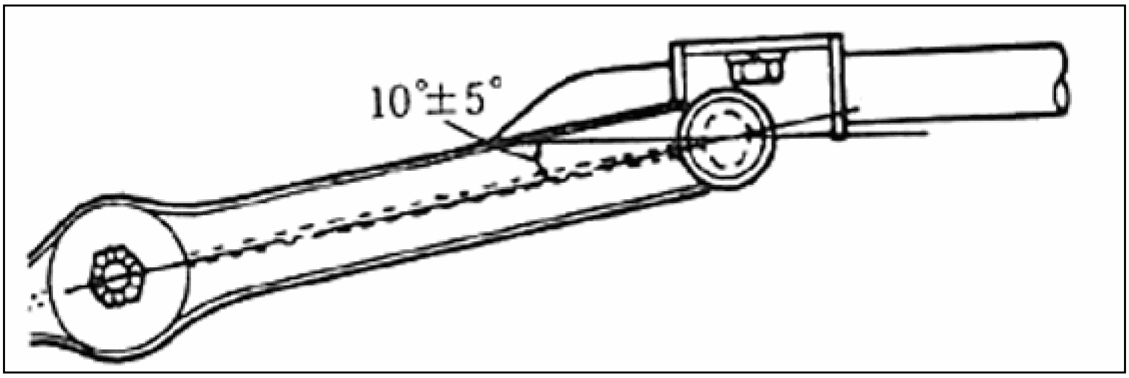


FIG 14-25

（2） After inserting ball joint of lower into knuckle hole，tighten nut to specified torque(FIG.14-21).

（3） After install the bolts connecting tension bar and lower arm, tighten nut to specified torque (FIG.14-20).

（4） After installing stabilizer link to tension rod, (FIG.14-19), tighten nut to specified torque.

（5） After installing tension bar, rubber bush and washer to tension bar bracket according to FIG.14-17, tighten nut to specified torque (FIG.14-18).

（6） Wheel installation can refer to wheel group.

CAUTION
Be sure to replace new tension bar nut.

14.3 REAR SUSPENSION

Rear suspension is shown in FIG.14-26.

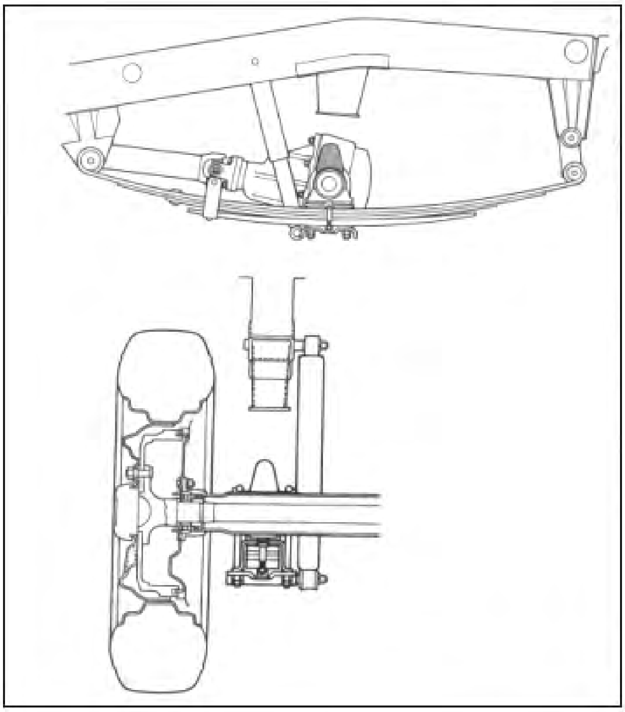


FIG.14-26

1 SHOCK ABSORBER

1） Removal steps

（1） Lift the vehicle;

（2） Remove the lower mounting nut.

（3） Remove the top mounting nut, and then remove rear absorber.

2） Installation

（1）Install shock absorber according to FIG.14-27.

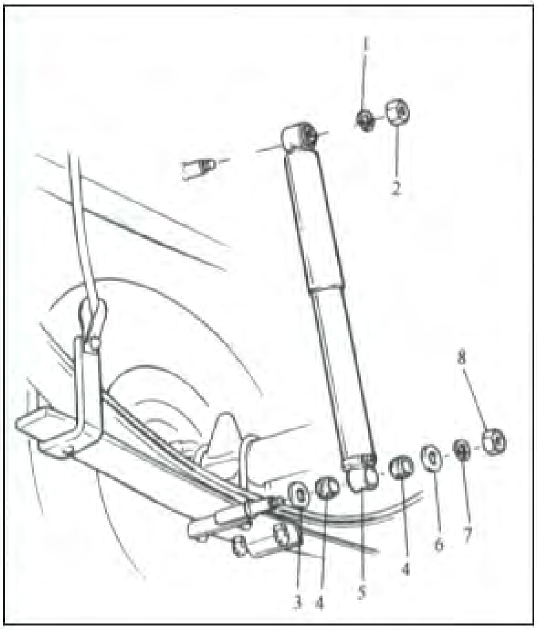


FIG.14-27

1-Heavy spring washer; 2-Nut; 3-Washer; 4-Bushing; 5-Shock absorber;
6-Washer; 7-Heavy spring washer; 8-Nut

（2）Tighten nut to specified torque.
（3）Fall the vehicle down.

2 LEAF SPRING

1） Removal steps

（1）Lift the vehicle, be sure not to put jack under rear suspension parts, when using crane, put safe bracket under chassis to support body.

CAUTION

Be sure not to suspend rear axle housing with brake hose to prevent the hose or pipe from being damaged. It is proper to lift rear axle housing with safety bracket.

（2）Take down parking brake cable from clip.
（1） Remove U type bolt mounting nut.
（2） Loosen front and rear mounting nut of leaf spring.
（3） Take out leaf spring front mounting bolt, then take down leaf spring.

2） Installation

It is the reverse of removal procedures. Pay attention to the followings

（1） Leaf spring rear bush

Apply some water or suds on bush before depress it.

CAUTION

Be sure not to make the bush contacting with oil.

（2） Leaf spring (FIG.14-28)

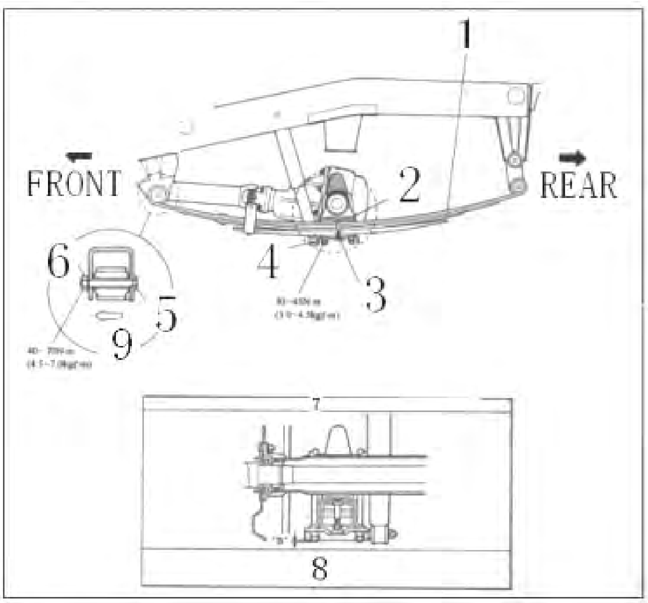


FIG.14-28

1：Rear leaf spring　　Every leaf should align with another on two sides. 2：Spring clamp plate.3：Center bolt and nut
4：Spring seat.5:Nut.6:Bolt.7：U type bolts and nuts.
8：Tighten four u type bolts and nuts uniformly until the dimensions “B” of the four nuts are the same.
9:Body center direction.

1.Install rear spring bolt from outside of body to inside.
2.Install leaf spring front mounting bolt from inside of body to outside;
3.Install center bolt and nut on the hole of leaf spring seat;
4.Tighten leaf spring front, rear mounting bolt and nut to specified torque with the vehicle in the unladen condition;
5.Fix parking brake cable with clip;
6.Install rear wheel, and tighten to specified torque.

7.Fall the vehicle down.

3) Service

(1) (1) Shock absorber (FIG.14-29)

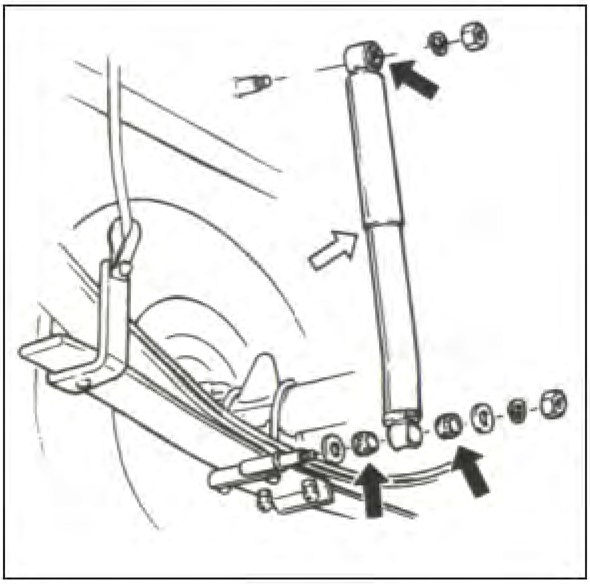


FIG.14-29

①Check for distortion or damage.

②Check bush for wear or damage.

③Check for leakage.

④Replace above disabled parts.

(2) Leaf spring and bumper

Check for crack or damage, replace if necessary. Check if bumper is well installed, replace if necessary.

（3）Leaf spring bush

Check bush for wear or crack, replace if necessary. If there is noise on the bush but no wear when driving the vehicle,

Remove the bush and apply specified grease to bush shown in FIG.14-30.

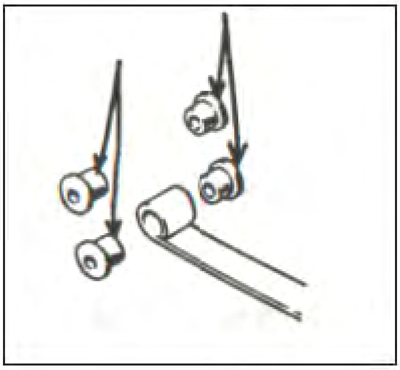


FIG.14-30

Apply thin silicon grease to all the area (be sure that the grease does not be harmful to the rubber)

The tightening torque of rear suspension can refer to Table 14-3，the position can refer to FIG.14-31.

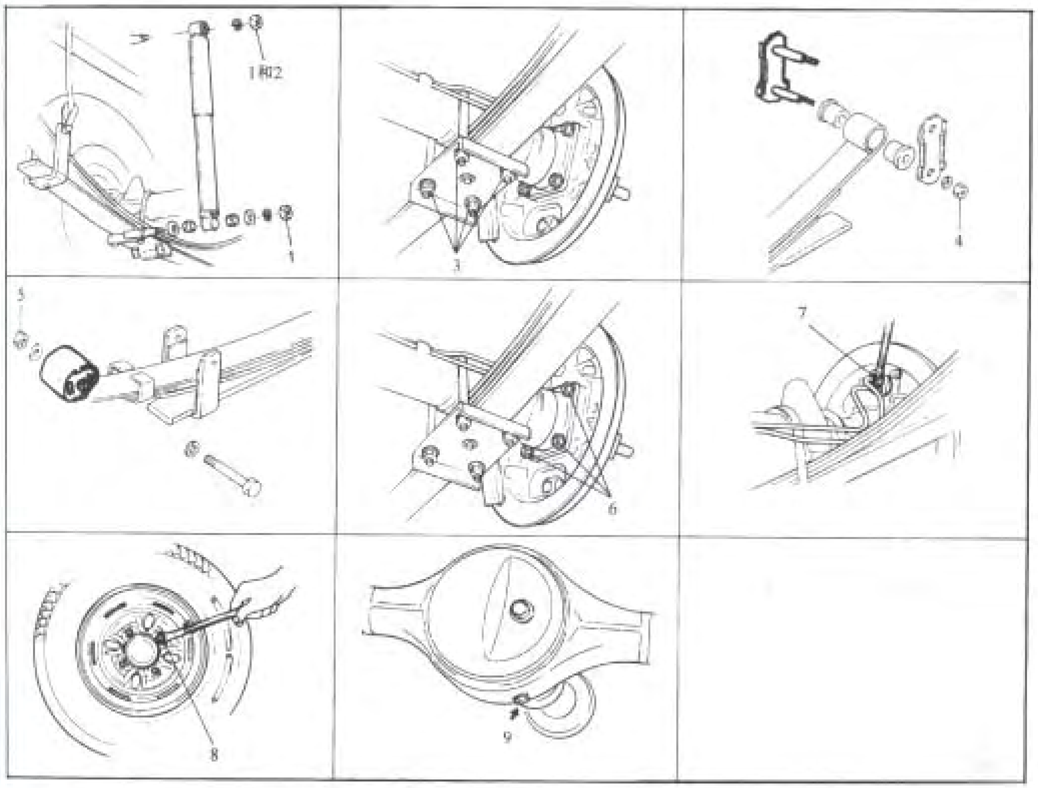


FIG.14-31

The limit doesn't include the runout amount produced by weld, scratch, paint and so on.

TABLE14-3

Tightening Parts	Tightening Torque （N.m）	
	N.m	kgf.m
1. Shock absorber bottom nut	10~16	1.0~1.6
2. Shock absorber top nut	22~35	2.2~3.5
3. U type bolt, nut	30~45	3.0~4.5
4. Leaf spring rear bolt, nut	30~55	3.0~5.5
5. Leaf spring front nut	45~70	4.5~7.0
6. Rear brake nut	18~28	1.8~2.8
7. Brake pipe cone-shaped nut	14~18	1.4~1.8
8. Rear wheel nut	80~90	8.0~9.0
9. Rear axle housing plug	40~70	4.0~7.0

14.4 TYRE AND WHEEL

●Tire Replacement

When replace the tire, ensure to use the tire with the same size as original. Replacement tires should be of the same size , load range and construction as those originally equipped on the car. Use of any other tire of different size or type may badly affected ride, handling, speedometer calibration, car ground clearance and body or chassis.

CAUTION

Do not mix different types of tires on the same car, except in emergencies. Because handling may be seriously affected and may result in loss of control.

It is recommended that new tires be installed in pairs on the same axle. If it is necessary to replace only one tire, it should be paired with the tire having the most tread to reduce the variation of braking force.

●Wheel Replacement

The wheel must be replaced when they are bent, damaged, and have excessive lateral or radial vibration, or when appeared exposure of welding point, enlargement of bolt holes, and corrosion. When the runout of wheel exceeding the limit on FIG.14-32, vibration will happen. Replacement wheel must should be same as original part with load, diameter, rim width, offset and installing style. Use of any other wheel of different size or type may affect wheel or bearing life time, brake cooling, speedometer indication and car ground clearance, tire, body and chassis clearance.

FIG.14-32

The limit doesn't include the runout amount produced by weld, scratch, paint and so on.

●Tire Inflation

Using specified tire pressure can bring satisfied performance on driving, stabilization, steering, tire wear, tire life and impact.

The inflation pressure of cool tire (parking time exceeds 3 hours or driving distance is less than 2km) should be checked every month. Check tire pressure (table 14-4) before a new journey.

Table 14-4

Item	165/70R13（155R13LT、155R13C）unladen	165/70R13(155R13LT 、155R13C) loaded
Front wheel	210（200）±10kpa	230（220）±10kpa
Rear wheel	210(200)±10 kpa	300（350）±10kpa

After driving, the tire pressure will increase 30~50kPa, which is normal. Don't try to release the pressure to ensure cool inflation pressure.

1）Higher than recommended pressure can cause;

(1) Hard riding condition;

(2) Carcass damage；

(3) Rapid wear of tire center tread.

2) Lower than recommended pressure can cause;

（1） Abnormal abrasion when it turns;

（2） Heavy steering control；

（3） Uneven wear of tread end;

（4） Scar of damage of tire rim；

（5） Break of tire cord；

（6） Increase of tire temperature；

（7） Unstable handling；

（8） High fuel consumption.

2）Unequal pressure on same axle can cause;
（1） Reduced braking performance;
（2） Handle trembling;
（3） Unstable steering;
（4） Swerve on acceleration.
The valve should be covered with cap to avoid dust and water entering.

● Tire Wear Check

Tread wear indicators are embed into tyre. If the remaining tread depth is less than 1.6mm or less, wear indicators of 12mm width band will appear. When there appear wear indicators on 3 or more tread grooves of six positions on tire, replace the tire. (FIG. 14-33)

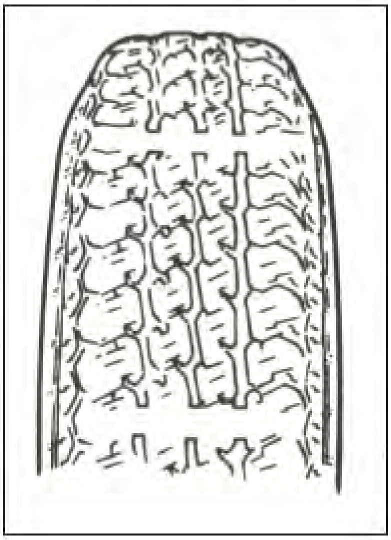


FIG14-33

●Tire Rotation

To equalize wear, rotate tires periodically. (Refer to FIG. 14-34)

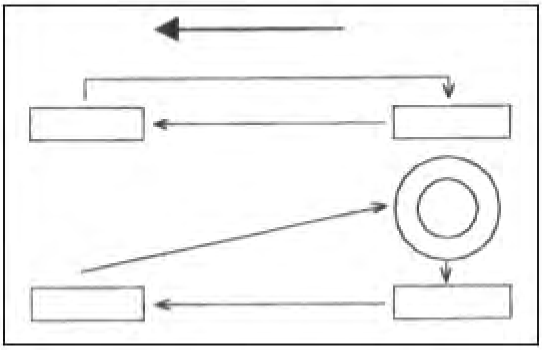


FIG14-34

●Wheel Removal

（1） Unscrew wheel nut about 180° (a half turn).
（2） Jack up the vehicle。
（3） Remove the wheel（FIG.14-35）。

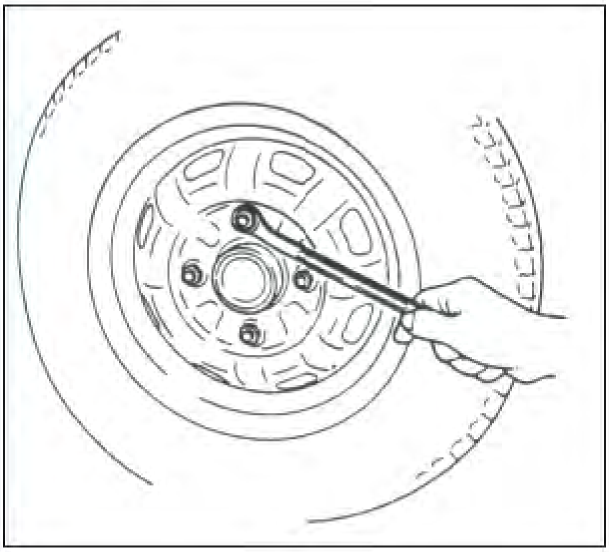


FIG14-35

CAUTION

Heating wheel to make wheel loose is not allowed because heating will reduce wheel lifetime and damage wheel bearing.

Wheel nut should be tightened to specified torque in order to avoid bend or deformation of wheel, brake drum or disc.（FIG.14-36）

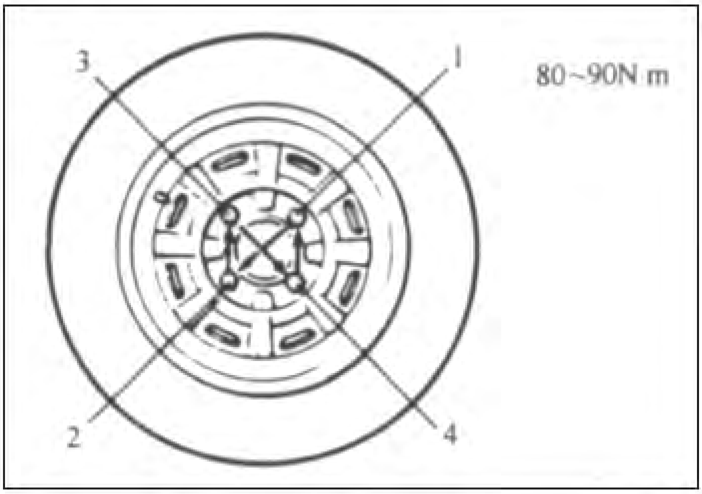


FIG14-36

CAUTION

Before installing wheel ， remove any buildup of corrosion on the wheel mounting surface and brake drum or brake disc mounting surface with scraper or wire brush. If not, can cause wheel nuts to loosen and it may released when running.

●Tire Removal And Installation

When replacing tires of wheels, comply with handbook of manufacture. Replacing by hand tools or tire lever only can cause damage to tire bead and wheel rim. Apply lubrication oil to bead seat of rim after removing strange materials such as old rubber debris or corrosions. After installing, charge to specified pressure and check if bead seat of rim fit well.

CAUTION

Don’t charge pressure out of specified value.

When charging , if specified pressure can’t make bead contacting closely, release some air, and lubricate and charge again.

Excessive inflation can cause breakage of bead, and damage tyre itself severely.

● Tire Overhaul

There are many kinds of overhaul material and equipment in the market. They are not effective for all types of tires, so the tire manufactures have made detail specification about tire overhaul time and method, which can abstained from tire handbooks.

●Wheel Service

It is not allowed to service wheel with the method as welding, heating, hammering. All the damaged wheel should be replaced.

● Adjustment Wheel Balance

Wheel tire balance is divided into static balance and dynamic balance. Static balance means the weight distribute equably along circumference direction. Imbalanced wheel will cause vibration, i.e. jounce which will cause abnormal wear of tire.(FIG.14-37)Dynamic balance means the attached weight on the two side of wheel centerline is equal. Then, there is not swing when wheel rotating. (FIG.14-38)

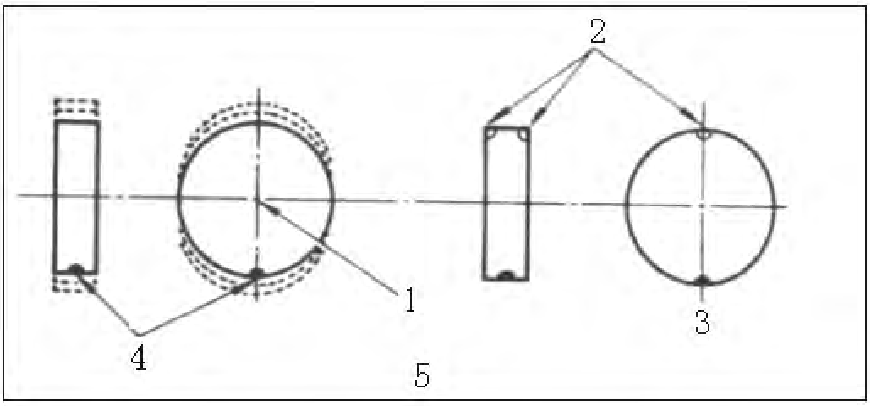


FIG14-37

1: Spindle center line. 2: Add balance weights.3: After adjustment.
4: Heavy spot wheel tramp. 5: Wheel static balance adjustment.

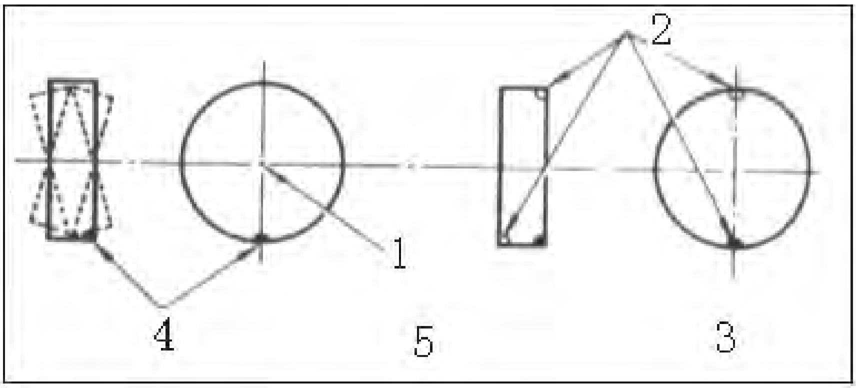


FIG14-38

1: Spindle center line, 2: Add balance weights, 3: After adjustment,
4: Heavy spot wheel tramp 5: Wheel dynamic balance adjustment

●General Wheel Balance Procedures

It is necessary to remove dirty away from wheel.

CAUTION

Stones and any strange materials should be removed from between patterns in order to avoid operator injury during rotation balancing, and abstain good balance.

Check tire for damage then adjust wheel balance according to handbook.

1) Off-the-car wheel balance

Most electron off-the-car balancers are exact than self-balance balancer on the car. They are easy to use and can carry dynamic (two planes) balance. Though it can not adjust imbalance of brake drum or disc like balance on the car, the error is within 3.5g in general, which can counteract the defect.

2) On-the-car wheel balance

The balance method is different along with different operator equipment and tools. Be sure to refer to wheel manufacture specification during operating.

15 STEERING SYSTEM

15.1 GENERAL DESCRIPTION

Steering system of the car adopts rack and pinion steering gear with two-end output. The steering gear is composed of rack and pinion. Turning steering wheel, the torque can be transferred to pinion through steering shaft and steering universal joint. The torque can be transferred to rack through the mesh of rack and pinion. In this way, the force of steering wheel is transferred to the knuckle through tie-rod and makes the wheel rotating.

15.2 REMOVAL

- Steering Wheel And Air Bag Removal

(1) Fireproof glove and glasses should be necessary when removing the steering wheel with airbag system.

(2) Loosen the four mounting bolts on steering wheel.

(3) Take out airbag module inside steering wheel. (Refer to FIG.15-1)

(4) Unclench the clip on the gas inflator seat by using a screwdriver, rotate gag inflator anticlockwise about 40° carefully, then take out the gas inflator.

(5) Loosen the steering wheel mounting nut and take down steering wheel from steering column.

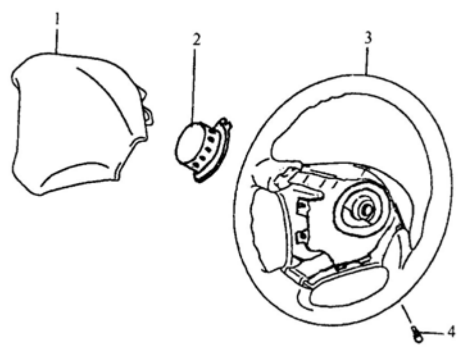


FIG.15-1

1-Airbag ;2- Gas inflator;3- Body of steering wheel ;4-Bolt

CAUTION
1. It is necessary to wear airbag protection equipment. 2. The gas inflator can't be used again if it drops from the height of 0.9m or more or damaged. 3. It is not proper to put the gas inflator on the environment with the temperature over 52℃. 4. When move the gas inflator, be sure to take with bottom flange and make the hole far away from people. 5. Don't make the gas inflator impacted severely. 6.Don't try to open the gas inflator, because the chemical medicine inside is harmful.

● Steering Wheel Without Airbag Removal

(1) Loosen the four mounting bolts on steering wheel, then take down the steering wheel cover.

(2)Loosen steering wheel mounting nut and take down steering wheel from steering column.

● Multi-Switch Removal

（1） Remove steering wheel (Refer to steering wheel removal) before removing multi-switch.

（2） Remove multi-switch cover (top and bottom)

（3） Disconnect wiring of multi-switch from connector.

（4） Remove clip of multi-switch wiring.

（5） Take down multi-switch from steering column.

● **Steering Column Removal (Refer to FIG.15-2)**

（1） **Remove steering wheel. (Refer to steering wheel removal)**

（2） **Remove** multi-switch. (Refer to①~⑤steps of multi-switch removal)

（3） Disconnect wiring of multi-switch from connector.

（4） Remove joint cover of steering shaft.

（5） Remove the bolt connecting lower shaft and joint of steering gear;

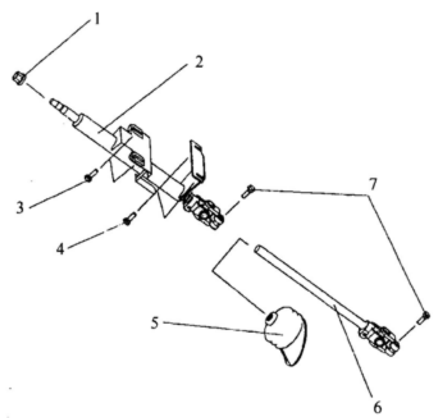


FIG.15-2

1-Steering wheel mounting nut;2- Steering upper shaft;3-Steering column upper mounting bolt;4- Steering column lower mounting bolt;5- Joint cover;6- Steering lower shaft;7-Steering shaft and joint connection bolt

（6） Remove steering column mounting bolt.

（7） Take down steering column.

CAUTION

If steering upper shaft being damaged，please go to the service station certificated from manufacturer to service or replace , it is not allowed to disassemble by oneself. Don’t operate hard during removal and installation to avoid damaging.

- **Tie Rod Ends Removal**

（1） Jack up the vehicle and take down the tyre.

（2） Remove cotter pin and castle nut from knuckle.

（3） Remove tie rod end by using special tool. (Refer to FIG.15-3)

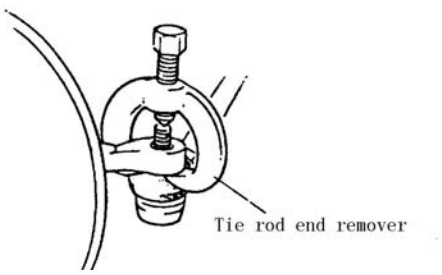


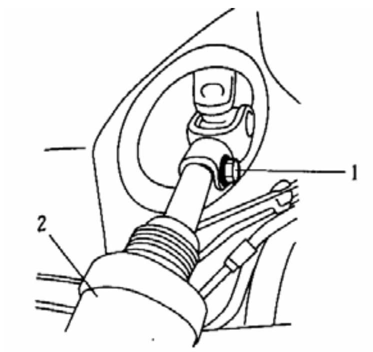
FIG.15-3

（4） To adjust expediently, it is necessary to make position sign of tie rod end lock nut on tie rod screw. After loosening nut, take down tie rod end from tie rod.

● Steering Gear Removal

（1） Jack up the vehicle and take down tyre.

（2） Remove connecting bolt of steering gear and steering lower shaft joint. (Refer to FIG.15-4)

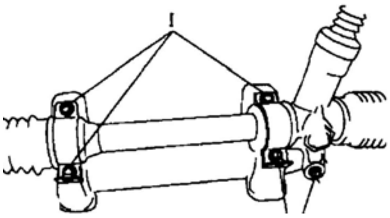


1.Mounting bolt; 2- Steering gear

FIG.15-4

（3）Remove tie rod end.(Refer to tie rod end removal)

(4) Remove steering gear mounting bolt, then take down steering gear. (Refer to FIG.15-5)



1.

FIG.15-5

1-Steering gear mounting bolt

15.3 DISASSEMBLY

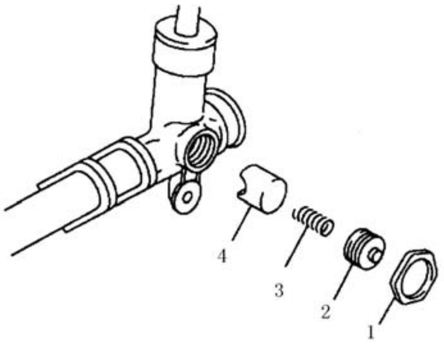
（1） Remove dust boot wire and clip.

（2） Take down dust boot of rack.

（3） Loosen gear and tie rod.

（4） Loosen locking nut, adjusting nut and take out spring.

（5） Take down rack plug. (Refer to FIG.15-6)



1. Lock nut 2. Adjusting nut 3. Spring 4. Rack plug

Fig.15-6

（6） Take down pinion boot.

（7） Remove seal, plug and O-ring.

（8） Knocking with a plastic hammer so as to disconnect pinion and case and take out pinion assembly.

（9） Take out rack in gear case.

（10）Take out needle bearing from case.

15.4 ASSEMBLY

(1) Clean all the parts prepared to install.

(2) Apply grease to needle of needle bearing.

(3) Depress needle bearing into rack case using special tool . (Refer to FIG.15-7)

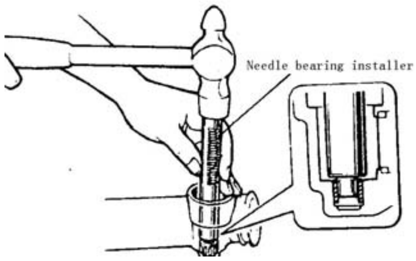


FIG.15-7

(4) After depressing, check needle bearing for right, firm and reliable installation5

(5) Apply grease to all the inner surface of bearing.

(6) Apply grease to all the inner surface and outer edge of rack.

(7) Put rack into rack case.

(8) Apply grease around the teeth of pinion, needle bearing and case oil seal lip.(Refer to FIG.15-10)

(9) Install pinion assembly.

(10) Depress oil seal into pinion bearing plug and depress bearing with plug，tightening torque:80～110N • m。

(11) Apply grease to sliding portion of rack supporting seat ，(Refer to FIG.15-8)，then install all the parts.

(12) After tightening the plug to the maximum, loosen it 90° and retighten adjusting plug to specified torque.

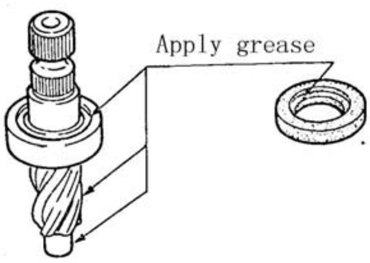


FIG.15-8

(13) Install limit ring and spring ring， ensure spring ring and rack knock fits well.

(14) Install rack cover dust and fasten with clip and wire. Be sure using new wire, after wrapping two circles, fasten 4～4.5 circles. Tighten the two ends together, and then bend along circle direction. Pay attention to the bend height and position so as not to affect steering gear installation and be sure not to damage rack cover dust.

(15) The installation procedures can refer to （1）～（8）steps of steering gear installation.

15.5 INSTALLATION

● Steering Gear Installation

（1） Ensure left and right wheel and brake disc (or brake drum) being in neutral position.

（2） Rotate pinion to adjust the protruding length of rack to ensure it being in neutral position.

（3） Install opinion into lower shaft joint.

（4） Install steering gear to crossmember， then tighten bolt to specified torque.

（5） Tighten connecting bolt between steering gear and lower shaft.

（6） Install wheel, and tighten nut to specified torque. (Refer to wheel installation)

（7） Fall the jack down.

（8） Check tie rod installation， adjust toe-in according to specification.

● Tie Rod End Installation

(1) Install tie rod lock nut and tie rod end to tie rod, and align lock nut with the sign on tie rod screw

(2) Connecting tie rod end with knuckle and tighten castle nut to specified torque， then insert split pin. (Refer to TABLE 15-5)

(3) Adjusting toe-in.

(4) After adjusting toe in well， tighten tie rod lock nut to specified torque.(Refer to TABLE15-5)

(5) Tighten wheel nut to specified torque. (Refer to wheel installation)

(6) Fall the jack down.

● Steering Column Installation

(1) Install joint cover on lower shaft.

(2) After aligning plain portion of lower shaft spine with joint bolt hole, insert lower shaft into joint.

(3) Install column upper and lower bracket, and tighten column mounting bolt to specified torque. Tighten lower bracket mounting bolt firstly and tighten to specified torque then tighten upper bracket mounting bolt.

(4) Install lower shaft and upper shaft joint mounting bolt and tighten to specified torque. (Refer to FIG.15-10, TABLE15-5)

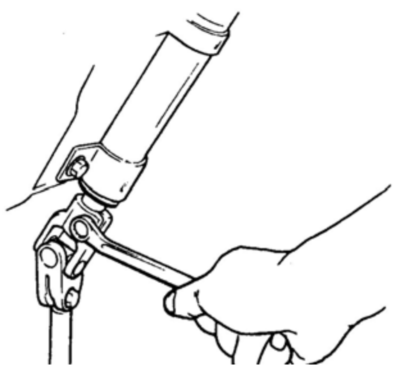


FIG.15-10

(5) Tighten connecting bolt between steering gear and lower shaft.

(6) Install joint cover into body hole reliably to make it not rotating.

CAUTION
Tighten joint bolt after tightening column bracket bolt.

(7) Connect ignition switch wiring.

(8) Install multi-switch. (Refer to （1）～（4）steps of multi-switch installation)

(9) Install steering wheel. (Refer to （1）～（4）steps of steering wheel installation)

● **Multi-Switch Installation**

(1) Install multi-switch.

(2) Connect multi-switch wiring，clip wiring with clamp under column.

(3) Install multi-switch cover，be care that the wiring should not be clipped by cover or column bracket.

(4) Install steering wheel. (Refer to steering wheel installation)

● **Steering Wheel Installation**

（1） Install steering wheel on upper shaft and make the sign on centerline.

（2） Tighten steering wheel nut to specified torque.

（3） Put airbag gas inflator on steering wheel and rotate clockwise until locked. (about rotating 40°)

（4） Align pin of airbag module with correspond hole on steering wheel. Depress module on airbag inflator hard, and then tighten side bolt of steering wheel to specified torque.

15.6 ON-CAR SERVICE

Steering system service (Refer to TABLE 15-1).

TABLE 15-1

Part		Condition	Correct	FIG.
Steering wheel		Free travel exceeding specified area. (Refer to TABLE 15-2）	Replace interrelated parts**	FIG.15-11
Steering column		① Sticking of upper shaft ② Bend, crack or deformation of column	Replace	
Steering gear	Opinion	① Wear or breakage of tooth surface ②Broken of seal	Replace	FIG.15-12
	Bearing	Sticking of bearing	Replace	
	Rack	① deformation exceeding specified area.（Refer to TABLE15-3） ② Wear or breakage of tooth surface	Replace	FIG.15-13

	Rack bush	Damage	Replace	
	Rack plug	① Wear of plug ② Wear of spring	Replace	FIG.15-14
Steering column assembly		Crack, breakage, wear or excessive free travel	Replace	
Dust cover of rack		Crack	* Replace	
Dust cover of tie rod		Crack	* Replace	FIG.15-15
Ball joint		Damage on end of screw.	Replace	FIG.15-16

Note：The position with “*” means checking rack cover dust for damage or breakage, when checking vehicle termly or jack up the vehicle for some reason.

The position with “* *” means keeping the vehicle in neutral position, then check if there is free travel of steering wheel or click.（Refer to TABLE 15-2）

TABLE 15-2

Free travel of steering wheel in circumferential direction	0～30mm

TABLE 15-3

Rack deformation value	0.35mm

（1） Lift up the vehicle.

（2） Check dust boot for damage.

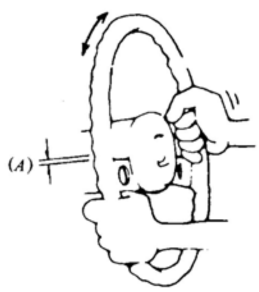
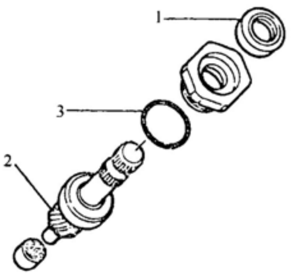


FIG.15-11



1- Seal；2-Pinion；3-Case seal ring

FIG.15-12

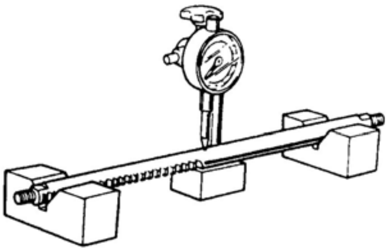
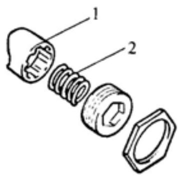


FIG.15-13



1- Rack plug；2-Plug spring

FIG.15-14

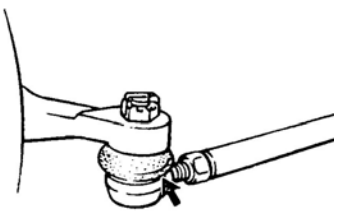


FIG.15-15

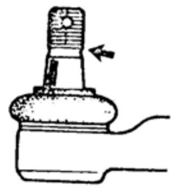


FIG.15-16

Water and dust is easy to enter into broken dust. Then, noise and rust will happened, which will make steering system being out of control. Replace cover dust in time when finding instinct crack on the cover dust.

(3) Check gap. If the gap exceeding standard value specified in TABLE15-2，check as follows and replace if it is defective.

a. check tie rod end for wear；

b. check steering shaft joint for wear；

c. check steering rack or pinion for wear and break；

d. check other part for looseness。

15.7 FRONT WHEEL ALIGNMENT

● GENERAL DESCRIPTION

The relation of front wheel, front suspension parts and the ground is called as front wheel alignment. In general, we adjust toe in only, camber, king pin and caster are not adjusted. Thus, when running in dangers road or camber, king pin or caster exceeding standard value, we should confirm if body damage or suspension damage, then service or replace the damaged parts.

Front wheel alignment can refer to TABLE 15-4.

TABLE 15-4

Toe in	2～5(mm)
Camber	1° 30′
Caster	3° 0′
Kingpin angle	9° 30′

● **TOE-IN ADJUSTMENT**

Adjusting toe in is to make steering wheel’s front shrunken than back to ensure parallel rolling of two front wheels.（faulty toe in will lead to tire wear）.

The front and rear distance difference (B-A) about two front wheel is the toe in. (unit: mm). (Refer to FIG.15-17)

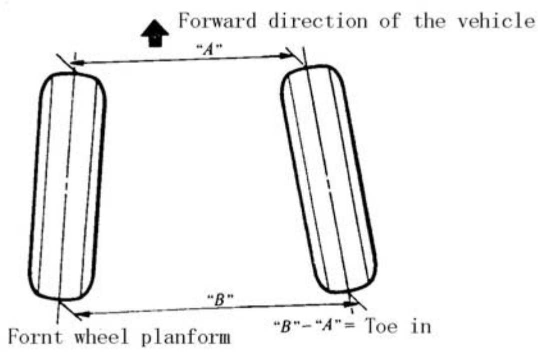


FIG.15-17

● CAMBER

Inclined degree of wheel to inward or outward, which is angle between centerline of wheel and vertical line. (Refer to FIG.15-18)

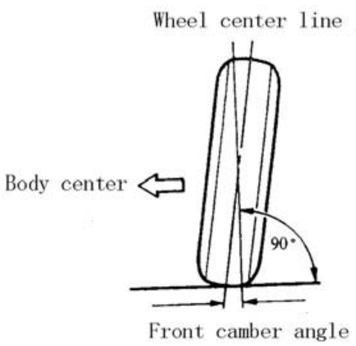


FIG.15-18

● CHECK BEFORE FRONT WHEEL ALIGNMENT ADJUSTMENT

Check as follows before adjusting to ensure right value and exact adjustment.

（1） Check if all the tyre pressure are same, and if all the tread wear are similar.

（2） Check steering and suspension system for looseness， before adjusting, ensure being reliable.

（3） Check steering wheel and tire for radial run-out.

（4） Check kit for overload，if the vehicle being at normal condition, remain it inside the vehicle before wheel alignment adjusting.

15.8 TIGHTENING TORQUE

TABLE 15-5

Tightening Parts	Tightening Torque (N.m)
Steering wheel mounting nut	28～38
Steering column mounting bolt	10～20
Steering lower shaft and steering gear mounting bolt	16～26
Airbag mounting bolt	7～11

Steering gear mounting bolt	16～26
Tie rod lock nut	40～50
Tie rod and knuckle connecting nut	35～45
Front crossmember mounting bolt	90～100
Steering shaft joint connecting bolt	20～30

15.9 SPECIFICATION OF STEERING GEAR

TABLE 15-6

Steering gear type	Rack and pinion
Max. inner steering angle	39° ±3°
Max. outer steering angle	36° ±3°

16 BRAKE SYSTEM

CAUTION

All the pars of brake system may affect brake system performance so as to result in major repair expense. When replacement is required, the same or equivalent parts should be supplied. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts.

16.1 GENERAL DESCRIPTION

When the foot brake pedal is depressed, hydraulic pressure is developed in the master through booster，then actuate pistons（front brake and rear brake）。

The master cylinder is a tandem master cylinder.（FIG.16-1）Two brake pipes are connected to the master cylinder and they make two independent circuits.

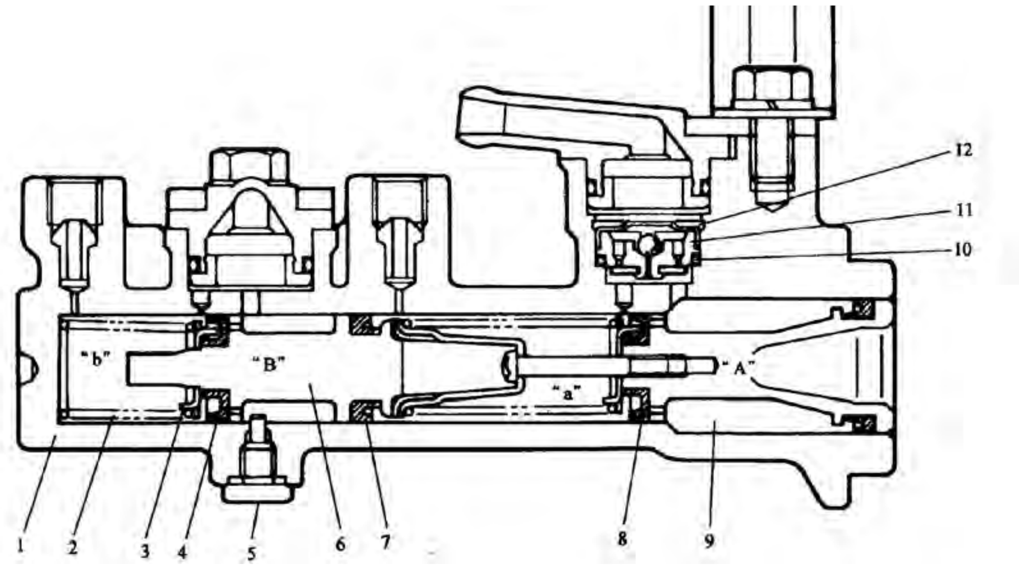


FIG.16-1

A-PRIMARY PISTON（CONNECTING LEFT AND RIGHT FRONT BRAKE）；B-SECONDARY PISTON（CONNECTING LEFT AND RIGHT REAR BRAKE）

1-Master cylinder body；2- Secondary piston return spring；3- Return spring secondary seat；4-Cup；5- Secondary piston support bolt；6- Secondary piston；7- Secondary piston pressure cup；8-Cup 9-Primary piston；10-O ring ；11-Valve12-Ring

●Master Cylinder

The master cylinder has two piston and three piston cups. Its hydraulic pressure is generated in the primary chamber(“a” in FIG.16-2) and secondary chamber (“b” in FIG.16-2) .The hydraulic pressure produced in primary chamber acts on the front brake(left and right) and the secondary chamber acts on the rear brake(left and right), (Refer to FIG.16-2)

CAUTION

Replace all components included in repair kits to service this master cylinder. Lubricate rubber parts with clean, fresh brake fluid to ease assembly. Do not use lubricated shop air on brake parts as damage to rubber components may result. I f any hydraulic component is removed or brake line disconnected. Bleed the brake system. The torque values specified are for dry, unduplicated fasteners.

CAUTION

Brake cylinder is important parts of brake system. When service or replacement is needed, please go to Hafei automobile service station for help. It is not permitted to remove by oneself.

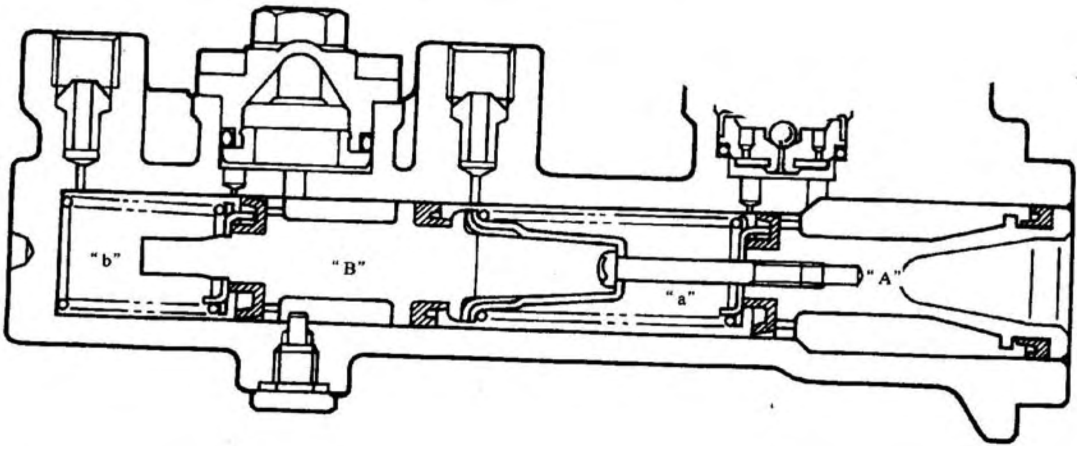


FIG.16-2

●Master Cylinder Operation

1）Normal Operation

Dressing the brake pedal forces primary piston"A"toward the left(in FIG.16-3) to pressurize the fluid immediately in "a". By this pressure and by the force of return spring, secondary piston "B" moves similarly to pressurize the fluid in "b".

2）One-Circuit Operation（ "a" circuit failure）

Depressing the brake pedal causes primary piston "A" to move as above but, the circuit connecting with "a" cannot hold pressure, the coterminous circuit does not get pressurized, the fluid immediately ahead of this piston does not get pressurized. Piston"A" keeps moving，compressing the spring and when it reaches the piston "B" retainer, it begins to push piston "B".From this point on, piston "B" moves to pressurize the fluid ahead and thus actuate the brake，(FIG.16-3)

3）One-Circuit Operation（ "b" circuit failure）

In this case, the leftward movement of piston "A" has but little effect in pressurizing its fluid at first, because the initial rise in fluid pressure causes piston "B" to promptly yield and move toward the left. Very soon the forward end of piston "B" comes to and bears against the head of the cylinder. From this point on, the leftward movement of piston "A" becomes effective to pressurize the fluid ahead of it for the brakes. the below Figure shows secondary piston "B" at halt.(FIG. 16-4)

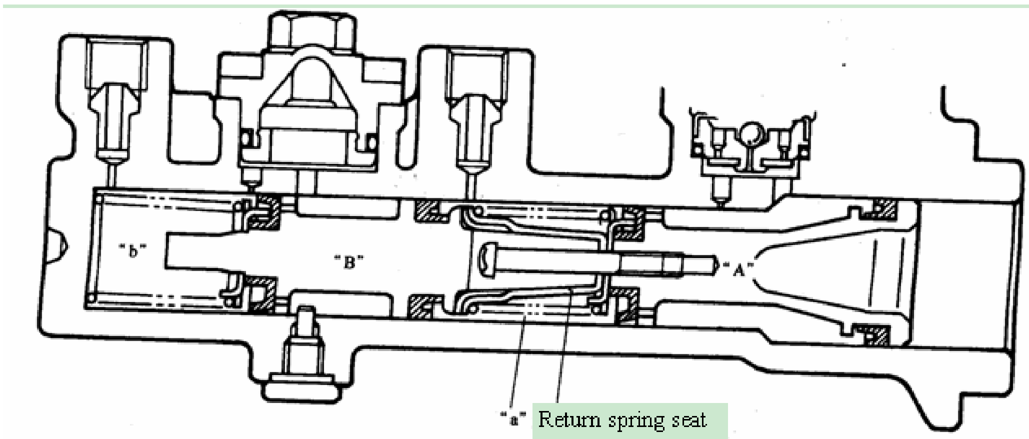


FIG.16-3

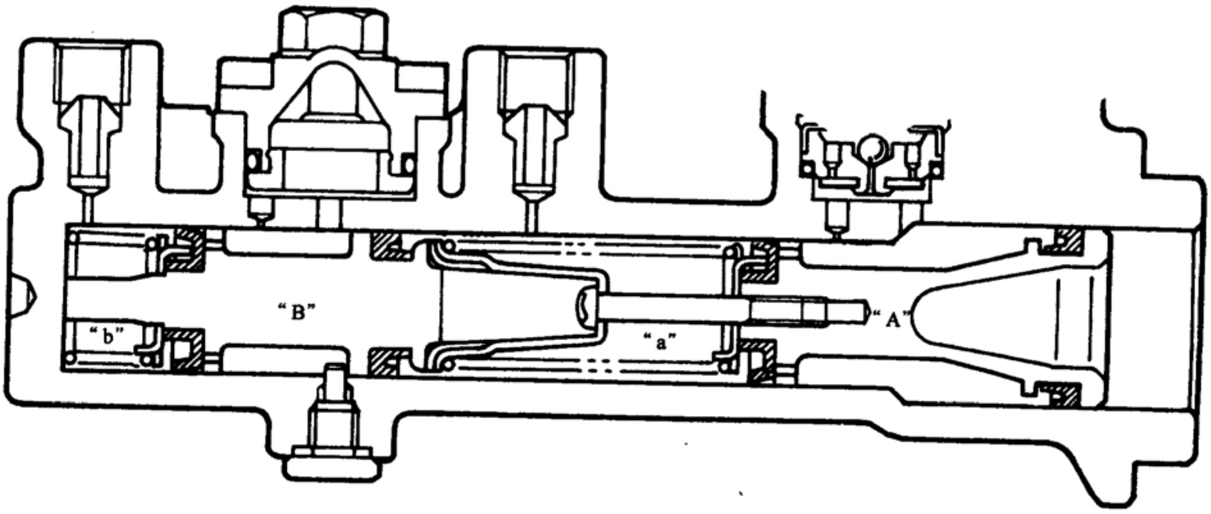


FIG.16-4

●Disc Brake Caliper Assembly

The caliper has a single 51.1mm bore and is mounted to the knuckle with two mounting bolts. Hydraulic force, created by applying force to the brake pedal, is converted by the caliper to friction. The hydraulic force acts equally against the piston and the bottom of the caliper bore to move the piston outward and to move the caliper inward resulting in a clamping action on the disc. This clamping action forces the pads against the disc, creating friction to stop the vehicle. (FIG. 16-5)

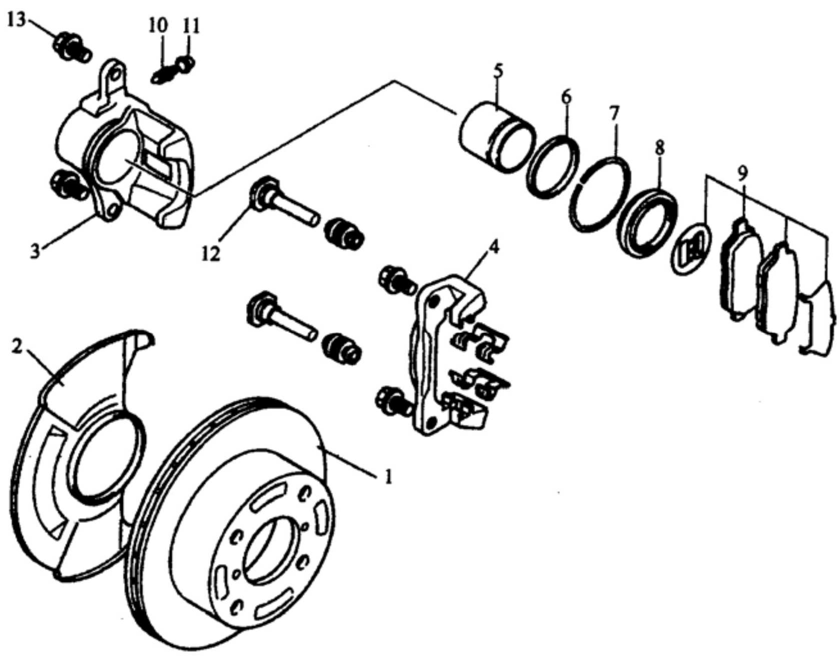


FIG. 16-5

1-Brake disc; 2-Dust; 3-Caliper body; 4-Caliper bracket; 5-Piston; 6-Piston seal; 7-Set ring; 8-Cylinder boot ; 9-Brake pads; 10-Bleeder plug; 11-Bleeder plug cap; 12-Caliper pin; 13- Caliper bolt

CAUTION

Lubricate parts as specified. Do not use lubricated shop air on brake parts as damage to rubber components may result. If any component is removed or line disconnected, bleed the brake system. Replace pads in axle sets only. The torque values specified are for dry, unlubricated fasteners.

●Caliper Operation

1）Single piston floating caliper type

The single piston floating caliper type brake is employed in this model. One cylinder and one piston are used for this type. (The cylinder is constructed as a monoblock with the caliper.) Fluid pressure generated in the cylinder causes the pad ① on the piston side to press against the disc. At the same time, the floating type caliper body is moved to the left by the cylinder pressure, as shown in below Figure, which pulls pad ② against the disc and so brakes the wheel. （FIG.16-6）

The disc brake has no servo assistance as in drum braking, and it is necessary to increase the working pressure of the piston and pad. For the purpose, the wheel cylinder has a large bore. Only a little change in clearance between the disc and pad has therefore a large influence on the brake pedal stroke. It is necessary to have the clearance adjusted to the minimum at all times, by means of the piston seal.(FIG.16-7)

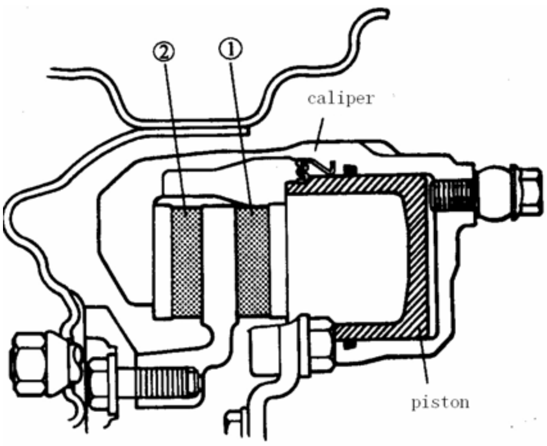


FIG.16-6

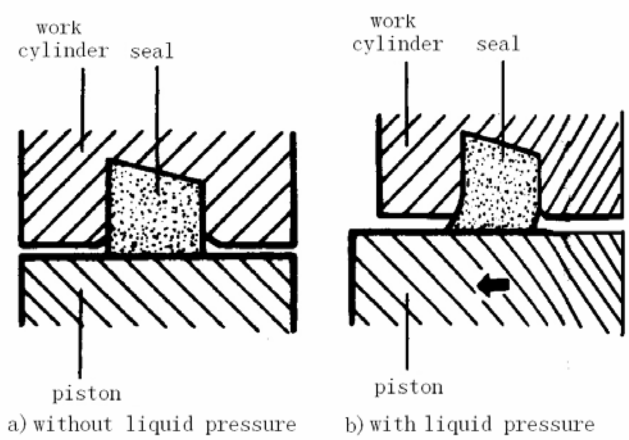


FIG.16-7

2）Clearance Correction

When fluid pressure is applied to the piston, the piston moves forward. The rubber seal, which exerts considerable pressure against the piston, moves with the cylinder. However, as a part of the rubber seal has been fixed into a groove in the cylinder, the shape of the rubber seal is distorted toward internal end of the cylinder, as shown in FIG..16-7. When pressure is taken off from the foot brake pedal and fluid pressure is released from the piston, a restoring force is generated at the seal and pushes the piston back. As the pads wear away and the clearance between the disc and pads becomes larger, the piston moves a large distance. The seal then could change in shape further but, since the end of the seal is fixed into the groove in the cylinder, the distortion is limited to the same amount as previously described. The piston moves further to cover the distance of clearance. The piston returns by the same distance and the rubber seal recovers its shape as described above and thus the clearance between the disc and pads are maintained in adjustment.

●Drum Brake Assembly (Rear Wheel Brake)

1）General Description

The drum brake assembly has a self-shoe clearance adjusting system so that drum-to-shoe clearance is maintained appropriate at all times. For details, refer to rear drum brake group. (FIG.16-8)

CAUTION

Replace all components included in repair kits used to service this drum brake. Lubricate parts as specified.

CAUTION

When servicing wheel brake parts, do not create dust by grinding or standing brake linings or by cleaning wheel brake parts with a dry brush or with compressed air.(A water dampened cloth should be used.) Many wheel brake parts contain asbestos fibers, which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm. If any hydraulic component is removed or brake line disconnected, bleed the brake system. The torque values specified are for dry, unlubricated fasteners.

2）Rear Brake Operation

With the general drum brake type, when the brake pedal is depressed, two pistons in the wheel cylinder force the brake shoes outward, restraining the turn of drum.

The most the brake shoes get worn，the longer distance the pistons must move. As a result, the brake pedal travel increase. The rear brake is provided with a self-adjusting system which automatically adjusts the shoe-to-drum clearance (pedal-to-wall clearance) caused by such brake shoe wear.

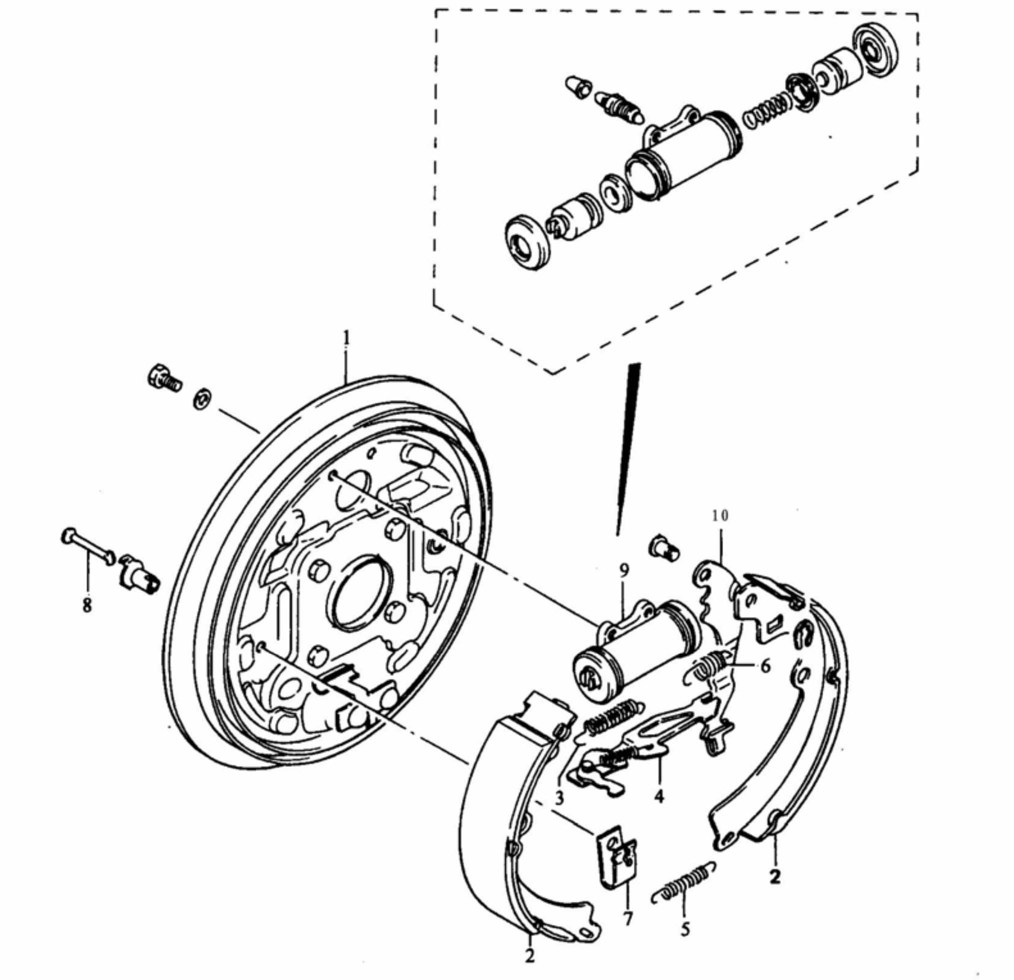


FIG.16-8

1-Brake back plate；2- Brake shoe；3-Shoe return spring（a）；4-Brake strut ；5- Shoe return spring（b）；6- Brake strut spring；7-Shoe hold down spring ；8-Shoe hold down pin；9-Wheel cylinder；10-parking arm

3）Clearance Correction

In each rear wheel cylinder, pistons, piston cups and a piston spring ① are installed. When the brake pedal is depressed, fluid pressure is applied to the inside of the chamber on the piston②、③.(FIG.16-9)

Being actuated by this pressure, the piston ② moves to the left(piston ③ moves to the right) and presses the brake shoe against the brake drum, thus producing brake force.

At the same time, the distance the brake shoe moves is "B", that is, the distance that "A"(the end of the long hole made in the brake shoes web) moves till it contacts the lever （1）which is fitted in the long hole.(FIG.16-10)

When the brake pedal is depressed, the piston and brake shoe move toward the brake drum side by the aforementioned distance "B" and "A" of the brake shoe web contacts the lever（1）.As the brake shoe gets worn and the brake shoe clearance becomes large, the force applied to the lever（1）at the time of such a contact becomes larger. When it exceeds 7~9kgf, the "A" of the brake shoe web moves the lever（1）as much as the amount of the brake shoe lining wear toward the direction as shown with an arrow in FIG.16-10.Thus the shoe is forced against the drum and the brake force is produced.

The distance the lever（1）moves corresponds to the amount of wear. In accordance with the lever（1）movement, the fan-shaped retchet（2） also moves, for they are assembled as a unit. The lever（1）and ratchet（2） remain in the positions as they moved until the shoe-to-drum clearance becomes even larger.

When the brake pedal is released, the brake shoe is allowed to move back by the amount of clearance "B" by means of the return spring. In this way, the brake shoe-to-drum clearance is automatically adjusted constant every time the brake pedal is depressed.

In terms of the brake drum diameter A—A，the brake shoe-to-drum clearance corresponds to 0.6~0.8mm.The spring provide in the wheel cylinder prevent the piston from moving back more than the specified brake shoe-to-Drum clearance (FIG.16-11)

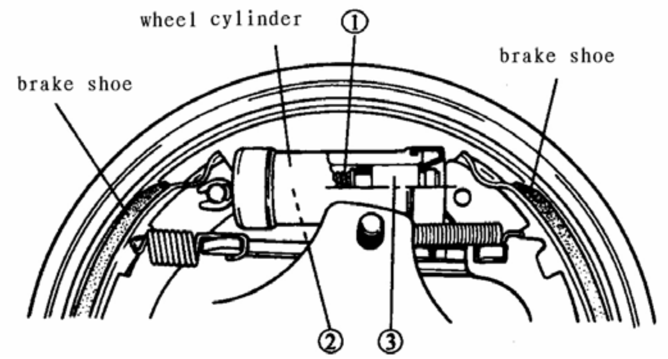


FIG.16-9

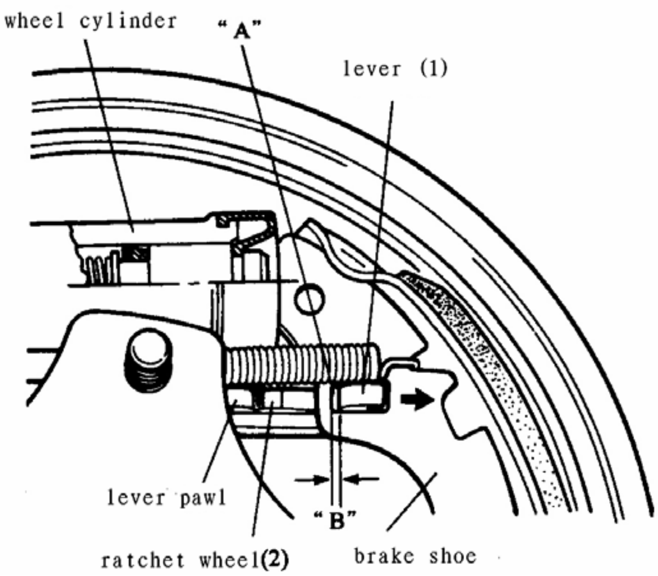


FIG.16-10

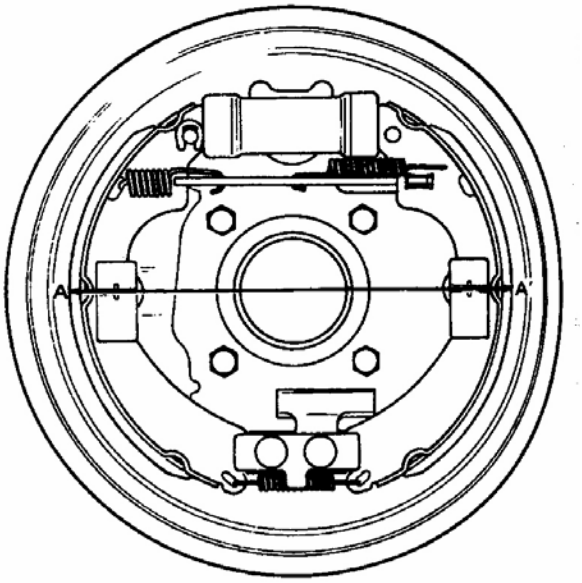


FIG.16-11

16.2 FRONT DISC BRAKE

- Removal

1）Brake Pad

（1）Loosen front wheel nut, but not remove wheel， jack up the vehicle with a jack.

（2）Remove wheel after jacking the vehicle safely, then take down the wheel.(FIG.16-12)

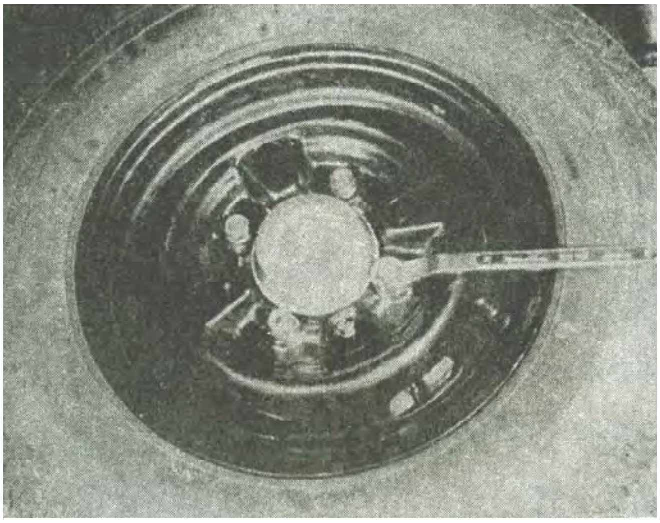


FIG.16-12

（3）Remove caliper mounting bolts.(FIG.16-13)

CAUTION
The guide pin is applied with special grease. Pay attention not to dirty guide pin when wiping special grease.

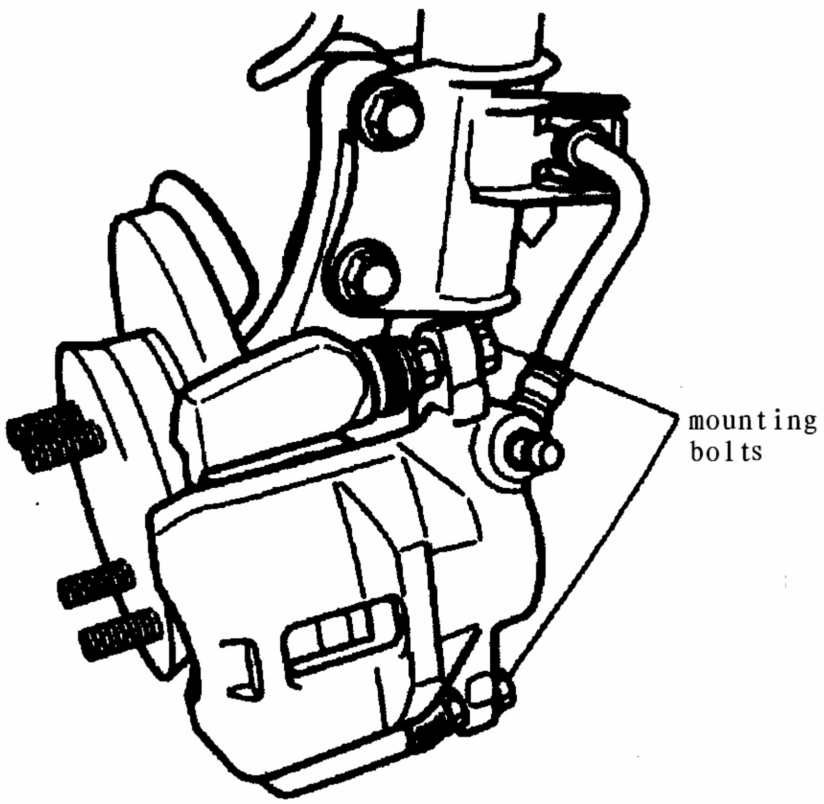


FIG.16-13

（4）Remove Caliper.(FIG.16-14)

CAUTION
Do not damage brake hose when removing, and do not depress brake pedal. Turn the removed caliper outward, and hang with a wire and so on.

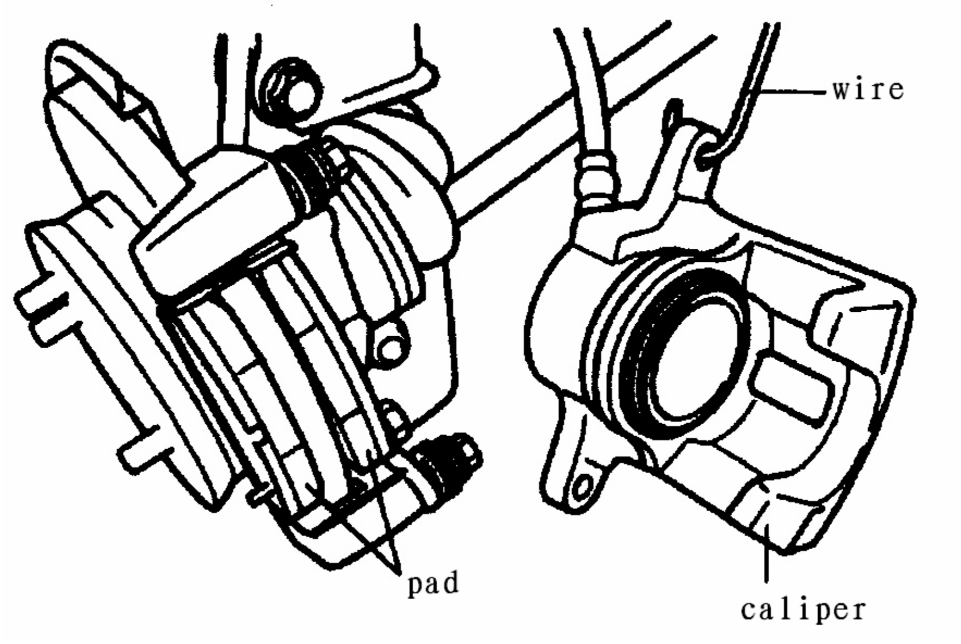


FIG.16-14

（5）Remove Pad.

2）Caliper, Piston and Seal

After removing wheel，remove piston and seal according to following procedure .

（1）Clean caliper.

（2）Remove brake hose from caliper.(FIG.16-15)

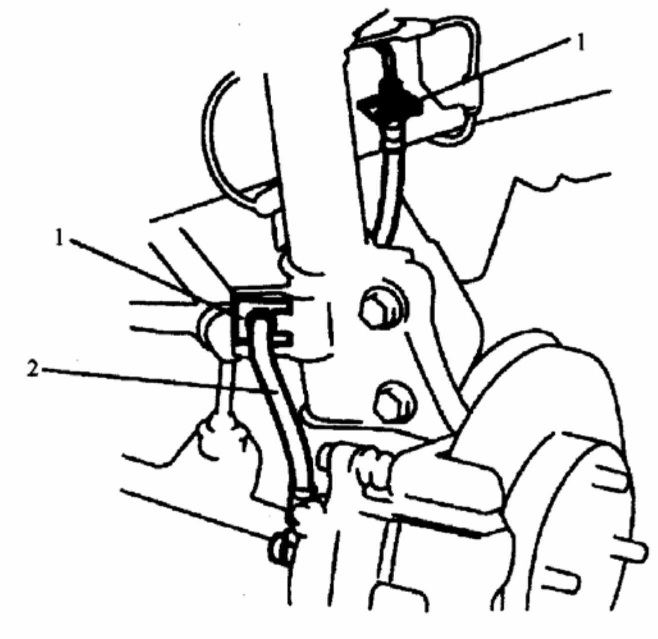


FIG.16-15
1.E - ring 2,Brake hose

（3）Remove caliper mounting bolts. (FIG.16-16)

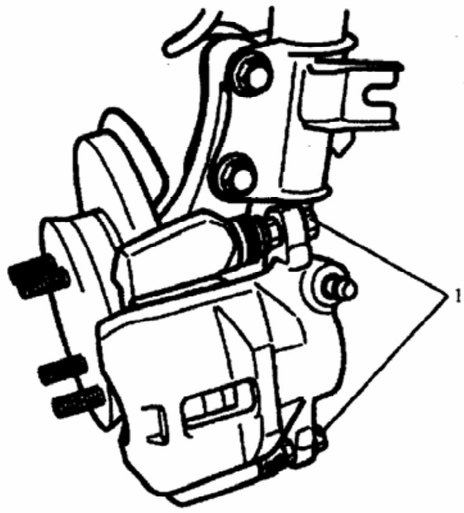


FIG.16-16 1.Mounting bolt

（4）Blow in compressed air into cylinder through bolt hole where hose was fitted. With this air pressure, piston can be pushed out of cylinder (FIG.16-17)

CAUTION
Do not apply too highly compressed air which will cause piston to jump out of cylinder. It should be taken out gradually with moderately compressed air. Do not place your fingers in front of piston when using com

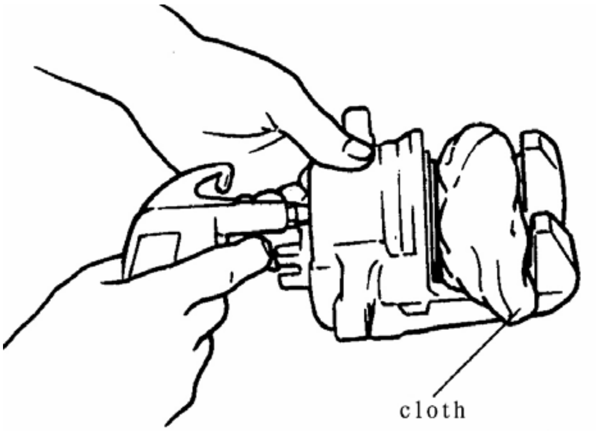


FIG.16-17

（5）Remove piston seal using a thin blade like a thickness gauge, etc(FIG.16-18)

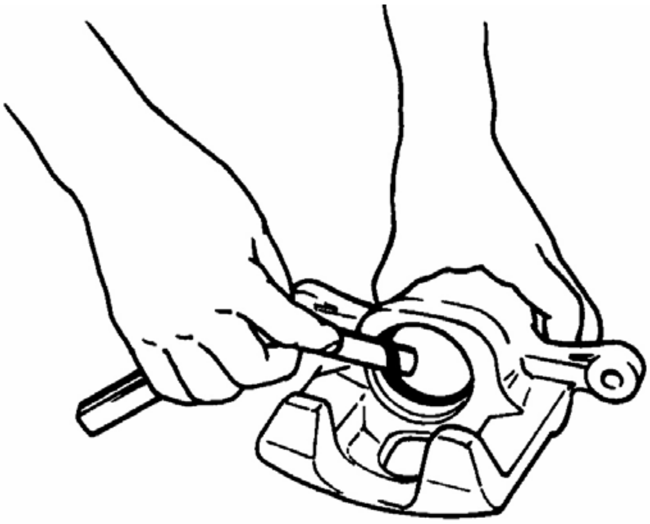


FIG.16-18

CAUTION
Do not damage inner surface of cylinder during removing.

3）Disc, Hub And Hub Bolts

（1） Remove caliper mounting bolts (FIG.16-13)

（2）Remove caliper from brake disc and hang it with a wire. (FIG.16-14)

CAUTION
Do not damage brake hose when removing, and do not depress brake pedal.

（3）Remove spindle cap as shown in FIG.16-19.（By hammering lightly at 3 locations around it so as not to deform or cause damage to seating part of cap）

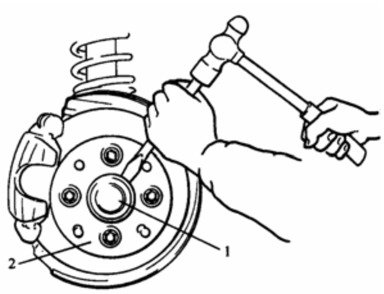


FIG.16-19 1.Cover dust; 2-Hub

（4）Draw disc from hub using two M8 bolts. (FIG.16-20)

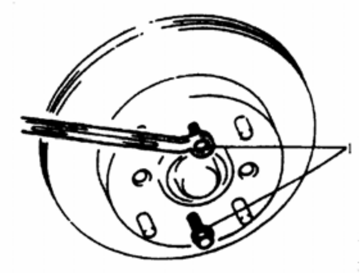


FIG.16-20　　1.M8 bolt

（5）Remove split pin.

（6）Remove castle nut and washer.

（7）Remove hub using special tool. (FIG.16-21)

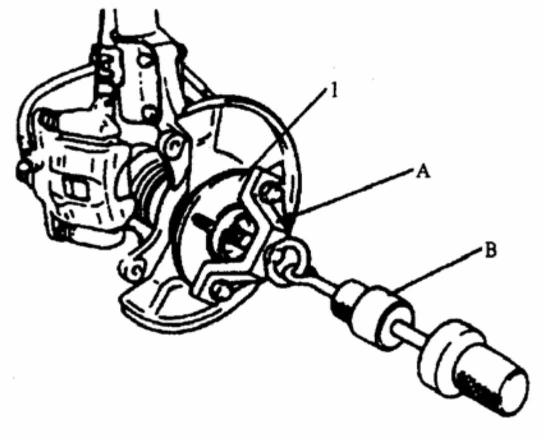


FIG.16-21　　1.Hub

（8）Put hub on a pad, and remove the bolt from hub using a hammer. (FIG.16-22)

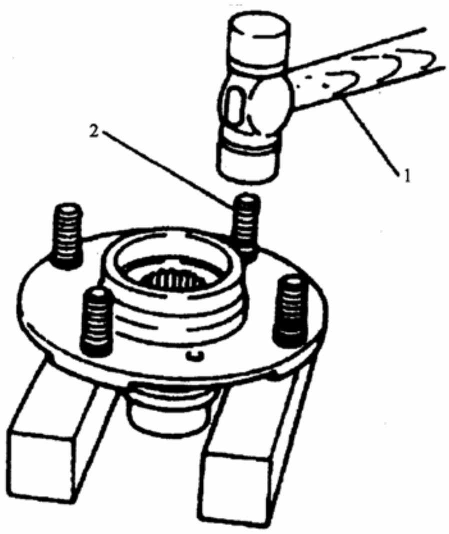


FIG.16-22　　　1.Hammer 2.Hub

CAUTION
After removing, be sure to replace new hub bolts. The wheel bearing and hub are designed unitary. Replace new hub if damaged.

- **Parts Inspection**

To measure the deflection of a disc, make measurements at 2 points on the periphery and center of the disc with a dial gauge, while rotating the disc.

1） Wheel Bearing

To measure axial play of wheel bearing, put a dial gauge on wheel center. When the measure value exceeding limit, replace wheel hub

TABLE 16-1

Limit of Axial Play	0.1mm

2） Pad Lining

Check pad lining for wear. When wear exceeds limit, replace with new ones. When the groove on pad lining is plain, replace a new one. (FIG.16-23)

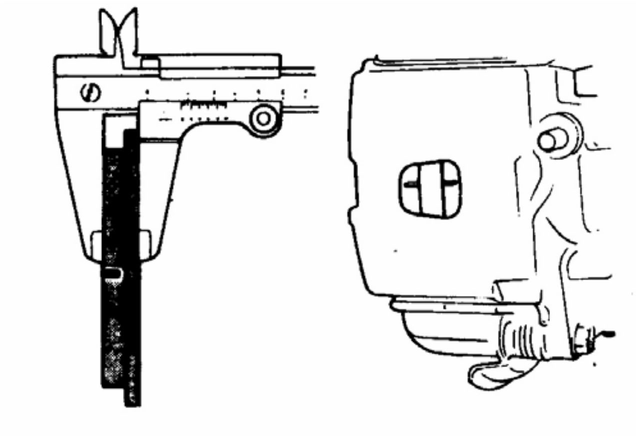


FIG.16-23

CAUTION

Never polish pad lining with sandpaper. If lining is polished with sandpaper, hard particles of sandpaper will be deposited in lining and may damage disc. When pad lining requires correction, replace.

TABLE 16-2

Pad Thickness(mm)	Standard	Limit
（Lining +Pad Rim）	15.5	6.0

CAUTION

When pads are removed, visually inspect caliper for brake fluid leak. Correct leaky point, if any.

3) Cylinder Slide Bush

Check bush for smooth movement. If it is found faulty, correct or replace. Apply rubber grease to bush outer surface. Rubber grease should be the one whose Viscosity is less affected by such low temperature as－40℃.（FIG. 16-24)

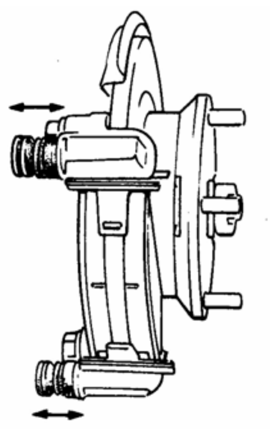


FIG. 16-24

4）Bush Dust Boot And Cylinder Boot

Check boots for breakage, crack and damage. If defective, replace. (FIG. 16-25)

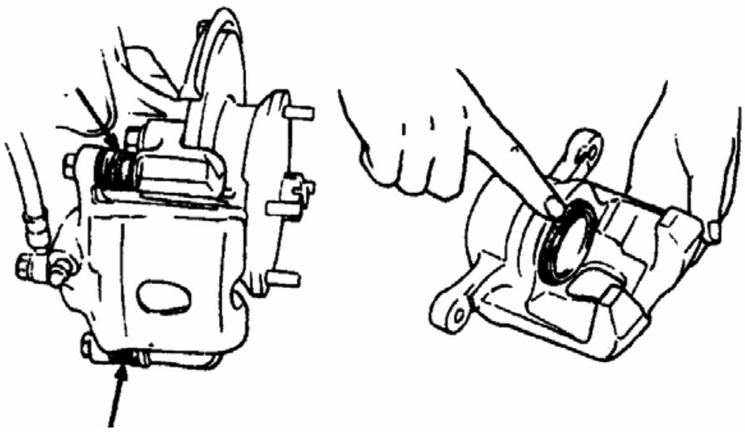


FIG. 16-25

5）Piston Seal

Excessive or uneven wear of pad lining may indicate unsmooth return of piston. In such a case, replace the rubber seal. (FIG. 16-26)

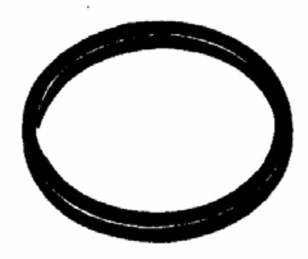


FIG. 16-26

6）Brake Disc

Check the disc surface for scratches in wearing parts. Scratches on the disc surface noticed at the time of the specified inspection or replacement are normal and the disc is not defective if these are not serious. But when there deep scratches or scratches all over the surface, replace the disc. When only one side is scratched, polish and correct that side. (FIG 16-27)

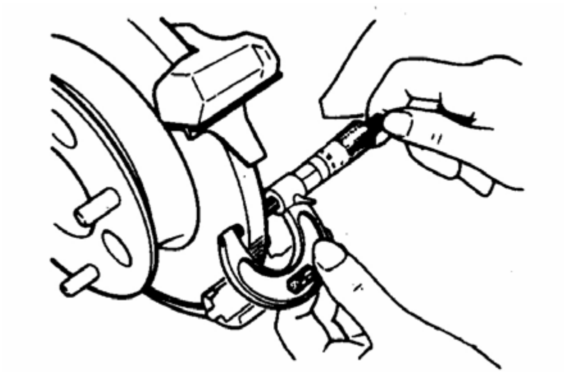


FIG 16-27

TABLE 16-3

	Standard	Limit
Disc Thickness (mm)	12	10

To measure the deflection of a disc, make measurements at 2 points on the periphery and center of the disc with a dial gauge, while rotating the disc. (FIG. 16-28)

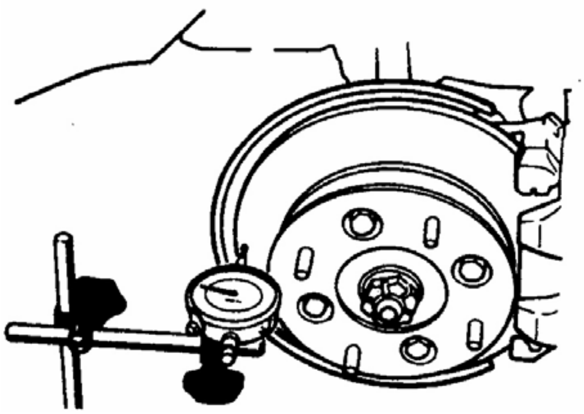


FIG. 16-28

TABLE 16-4

Limit On Disc Deflection	0.15mm

CAUTION
Check front wheel bearing for looseness before measurement.

- **Pay Attention to the Following before Installing**

Reassemble front brake in the reverse order of disassembly, noting the following points:

CAUTION

1. Wash each part cleanly before installation in the same fluid and the one used in master cylinder reservoir.
2. Never use other fluid or thinner.
3. Before installing piston and piston seal to cylinder, apply fluid to them.
4. After reassembling brake line, bleed air from line.
5. When installing spindle cap, hammer lightly several locations on the collar of cap until the collar comes closely into contact with brake drum. If fitting part of cap is deformed or damaged or if it is fitted loosely, replace with new one.

1） Piston Seal

Piston seal is used to seal piston and cylinder and to adjust clearance between pad and disc. Replace with a new one at every overhaul. Fit piston seal into groove in cylinder taking care not to twist it.

2） Piston and Boot

(1) Before inserting piston into cylinder, boot must be fitted in piston. (FIG.16-29)

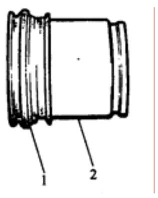


FIG.16-29　　1-Cover dust;2-Piston

(2) Install boot into cylinder groove using hand. (FIG.16-30)

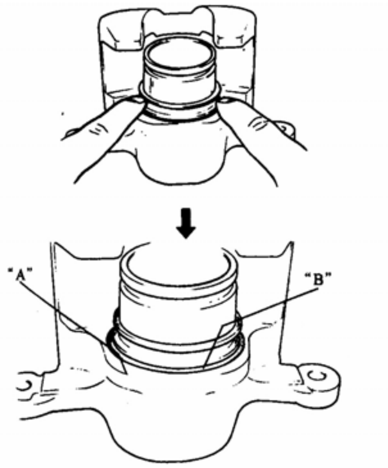


FIG.16-30 "B" surface of cover dust and "A" surface of cylinder body are on the same plane

(3)Install piston into cylinder with hand, then install boot into piston groove. (FIG.16-31)

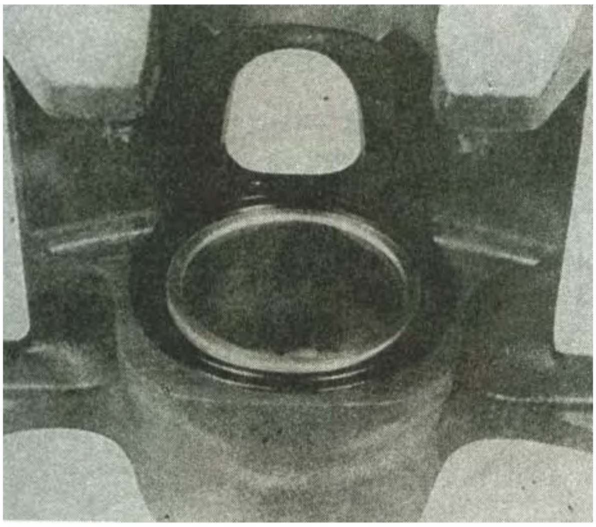


FIG.16-31

(4)After ensuring that the boot has been install into cylinder groove rightly, pull piston from cylinder out a littler but not take out.(FIG.16-32)

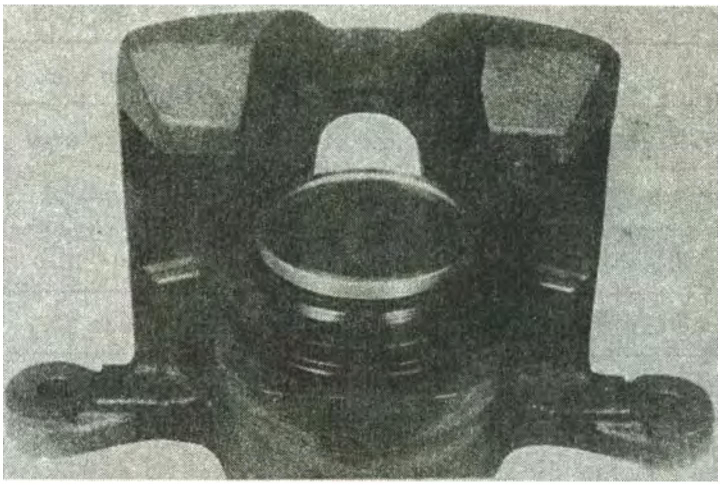


FIG.16-32

(5) Insert piston into cylinder with hand.

3） Hub

（1）While turning hub, drive it in with plastic hammer until its even installation is confirm. Push the hub in with special tool. (FIG.16-33)

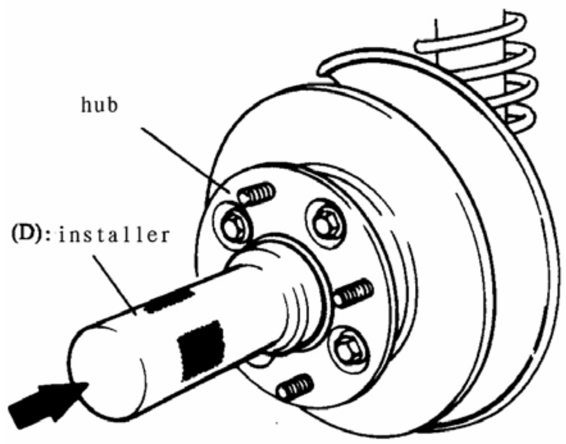


FIG.16-33

（2）Tighten castle nut to specified torque. Insert split pin and bend it.

4） Caliper

Before installing caliper to knuckle, check to ensure that slide bush are rubber greased and that slide bush inserted in each carrier hole can be moved smoothly in thrust direction.

CAUTION

Where temperature gets as low as -30℃ in cold weather, use rubber grease whose viscosity varies very little even at -40℃.

- **Tightening Torque**

TABLE 16-5

Tightening part	N • m	kgf • m
Knuckle and front hub nut	175~190	17.5~19.0
Brake hose and pipe plug	15~18	1.5~1.8
Caliper bolt	70~100	7.0~10.0
Caliper guide pin bolt	29.4~37.7	2.94~3.77
Wheel nut	80~90	8.0~9.0

1） Front brake hose

Install brake flexible hose as shown and torque hose mounting bolt to specification.

CAUTION

After completing installation, fill reservoir with brake fluid and bleed brake system. Perform brake test and check each installed part for oil leakage.

2） Check after installing brake

After installing wheel, rotate wheel with the force of 3.3kgf or less. The wheel should rotate smoothly. (FIG.16-34)

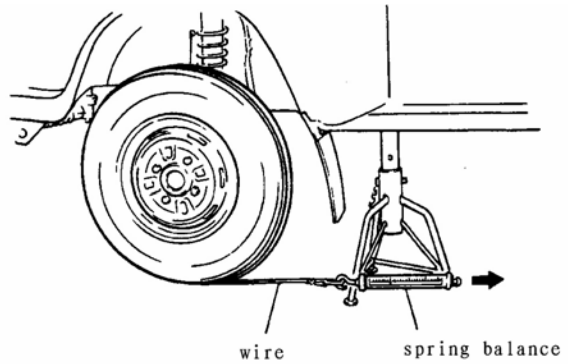


FIG.16-34

CAUTION
When carrying above inspection, pay attention to the followings：
1．Jack up the front until left and right wheels being free
2．The figure shown in FIG.16-34 is the value pulling tyre out rim.
3．Be sure not to depress brake pedal when checking wheel rotation.

If the rotation of tyre is hard, checking the followings：

（1）Check wheel bearing for wear.

（2)brake disc planar（incorrect planar can make rotating disc contacting with friction pad to result in hard wheel rotation）.

When checking this item, check brake disc run out at the same time.

16.3 REAR DRUM BRAKE

- **Removal**

1）Brake drum and brake shoe

（1）inspect if parking brake lever has been pulled up;

（2）Loosen wheel nut, but do not remove wheel;

（3）Jack up the vehicle and ensure to supported reliably. Remove wheel nut and take down rear wheel. There are four nuts on every wheel. (FIG.16-35)

（4）Pull brake shoe mounting pin stopper slice attached to the back side of brake rear plate out 5mm along the vehicle centerline direction，so as to increase clearance between brake shoe and brake drum. (FIG.16-36)

（5）Pull brake drum off by using M8 bolt. (FIG.16-37)

（6）Rotate brake shoe pin, and hold down spring. (FIG.16-38)

（7）Remove parking brake cable from parking shoe lever and remove brake shoe. (FIG.16-39)

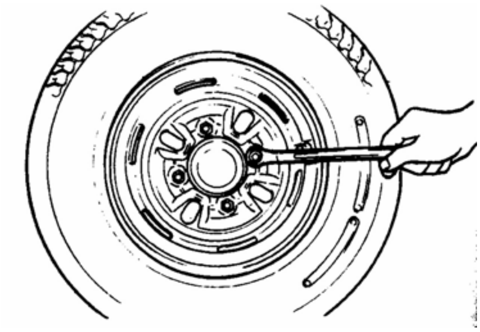


FIG.16-35

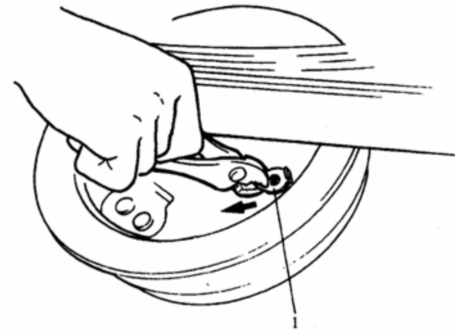


FIG.16-36 1-pin locating plate

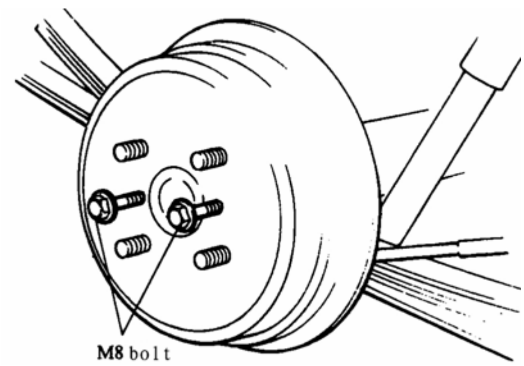


FIG.16-37

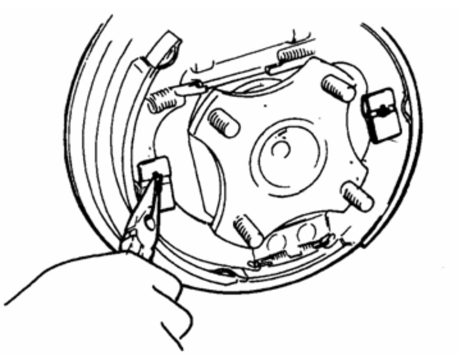


FIG.16-38

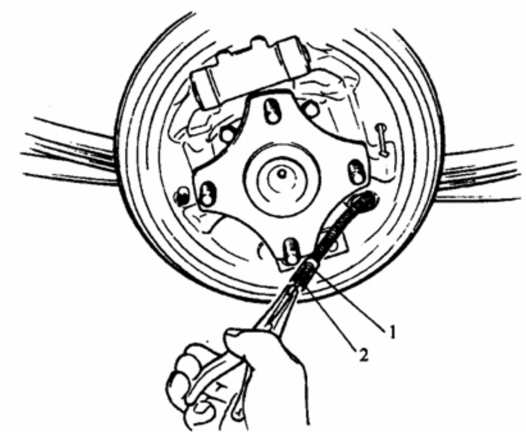


FIG.16-39 1-Parking brake shoe arm;2-Parking brake cable

2）Wheel Cylinder

（1）The removal of brake drum and brake shoe refer to installation section.

（2） Loosen brake pipe flare nut from wheel cylinder，and take out fluid with a syringe or such. (FIG.16-40)

（3）Remove wheel cylinder mounting bolts and put wheel cylinder breather plug cap onto pipe to prevent fluid from spilling. (FIG.16-41)

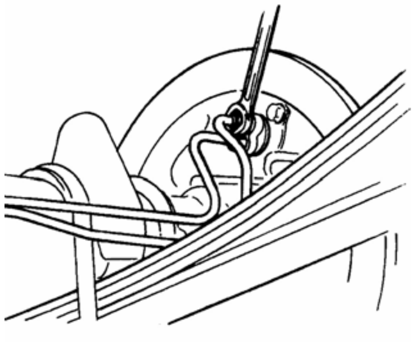


FIG.16-40

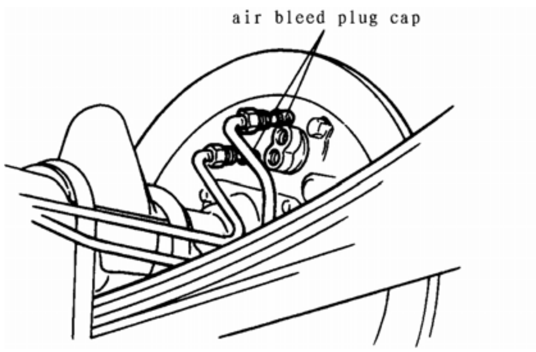


FIG.16-41

●Components Inspection

1）Brake Drum

Inspect drum for cleanliness. Check wear of its braking surface by measuring its inside diameter. (FIG.16-42)

Item	Standard	Service Limit
Brake drum ID	220mm	222mm

Whenever brake drums are removed, they should be thoroughly cleaned and inspected for cracks, scores, deep grooves.

Cracked, Scored, or Grooved Drum：

A cracked drum is unsafe for further service and must be replaced. Do not attempt to weld a cracked drum. Smooth up any slight scores. Heavy or extensive scoring will cause excessive brake lining wear and it will probably be necessary to resurface drum braking surface.

If brake linings are slightly worn and drum is grooved, drum should be polished with fine emery cloth but should not be turned.

Caution:

When drum is removed, visually inspect wheel cylinder for brake fluid leak. Correct leaky point, if any

2）Brake Shoe and Lining

While lining is worn out beyond service limit, replace shoe. (FIG.16-43)

TABLE16-7。

Brake Lining	Standard	Service Limit
Thickness （ Lining +Shoe Rim）	7.0mm	3.5mm

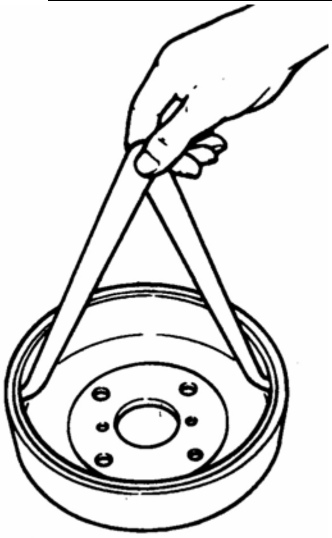


FIG.16-42

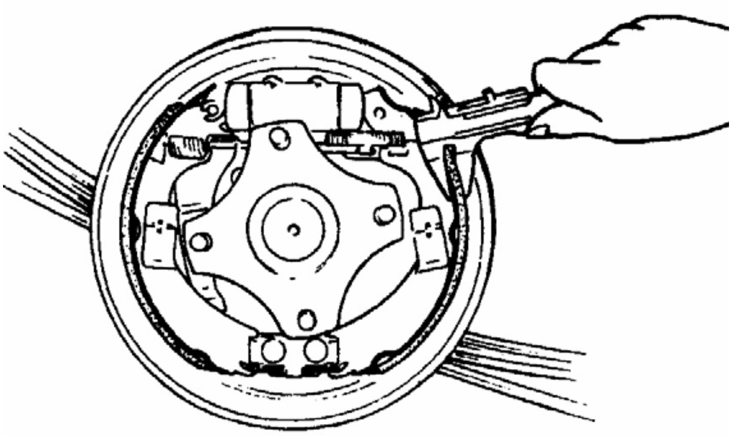


FIG.16-43

If one of brake linings is worn to service limit, all linings must be replaced at the same time.。

CAUTION

Never polish lining with sandpaper. If lining is polished with sandpaper, hard particles of sandpaper will be deposited in lining and may damage drum. When it is required to correct lining, replace it with a new one.

（1）Wheel cylinder

When removing brake drum，check wheel cylinder for leakage. Replace if any.

Inspect the wheel cylinder disassembled parts for wear, cracks, corrosion or damage. (FIG.16-44)

（2）Brake strut

Inspect ratchet of strut for wear or damage. (FIG.16-45)

（3）Spring

Inspect for damage or weakening. If found defective. Replace. (FIG.16-46)

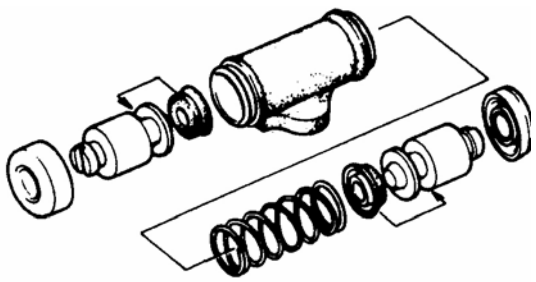


FIG.16-44

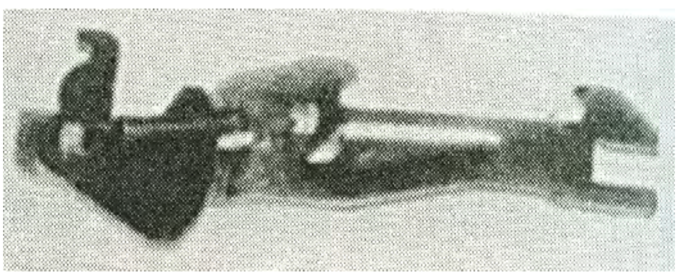


FIG.16-45

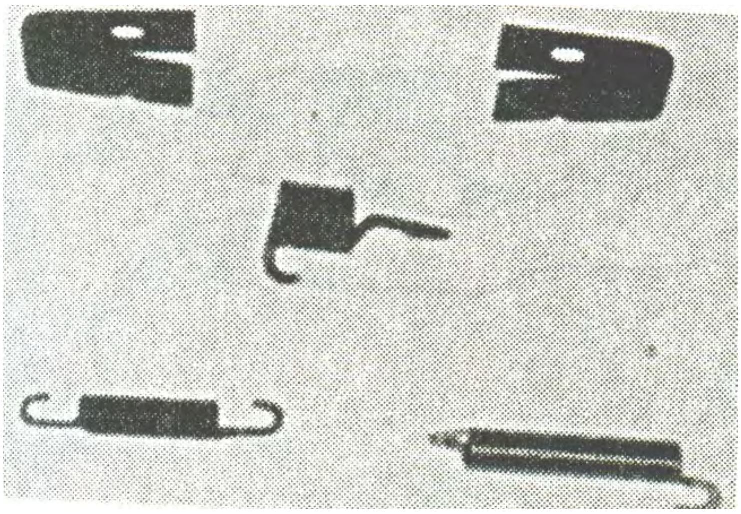


FIG.16-46

● Service Point

1）Brake wheel cylinder

（1）Apply sealant between brake back plate and wheel cylinder.

（2）Tighten wheel cylinder to brake back plate to specified torque.

（3）Tighten flare nut of brake pipe to specified torque.

（4）Install breather plug cap taken off pipe back to breather plug. (FIG.16-47)

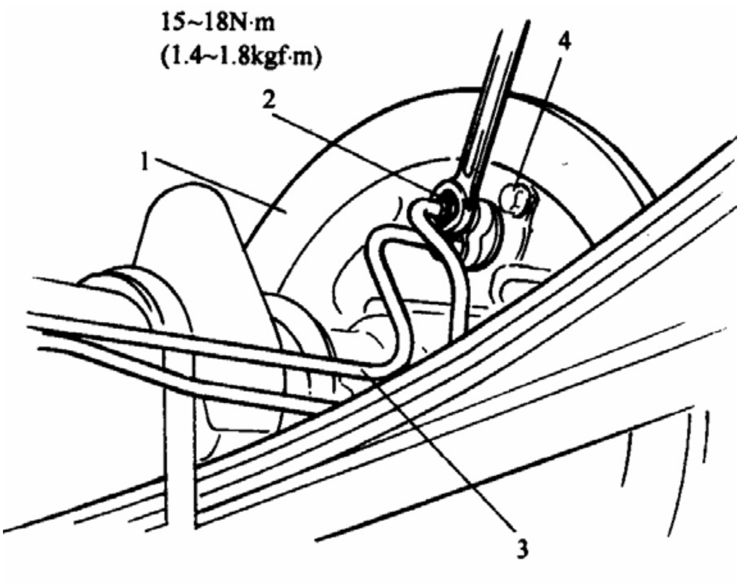


FIG.16-47：1-Brake back plate；2-Brake pipe flare nut；3-Brake pipe；4-Wheel cylinder bolts

2）Brake Shoe

（1） Apply sealant between brake back plate and brake cable，and run paring cable through brake back plate and secure it with clip(FIG.16-48, 16-49)

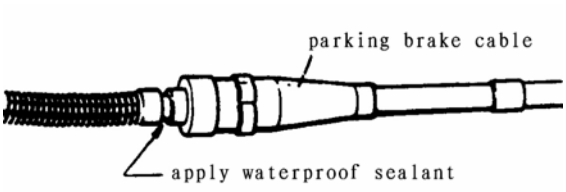


FIG.16-48

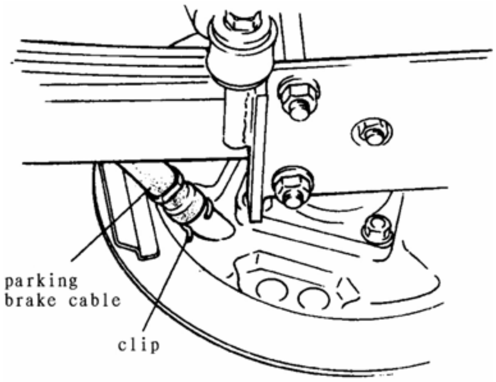


FIG.16-49

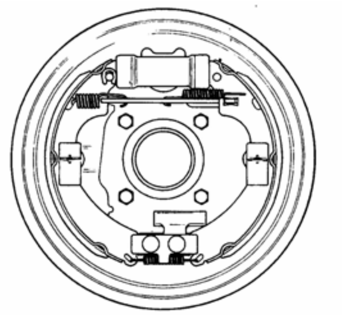


FIG.16-50

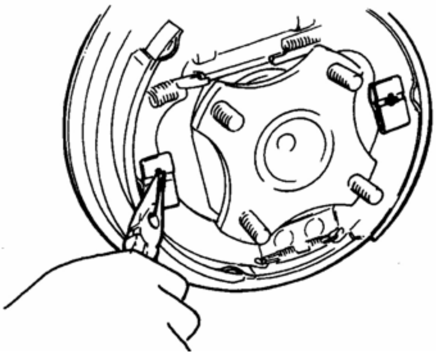


FIG.16-51

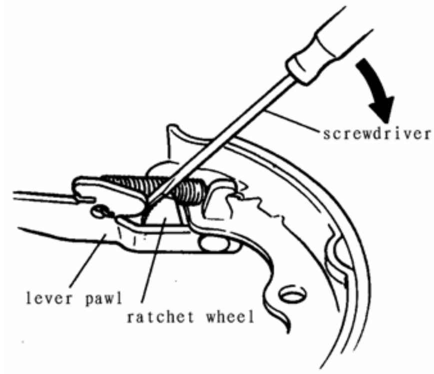


FIG.16-52

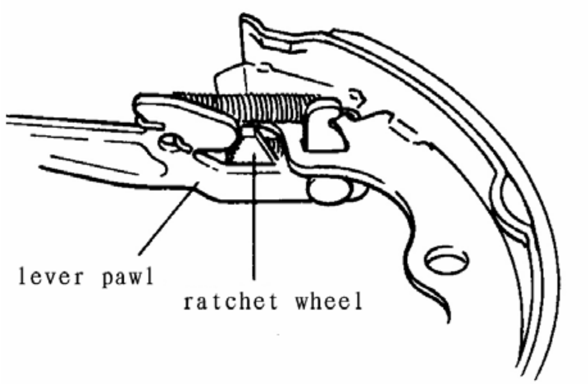


FIG.16-53

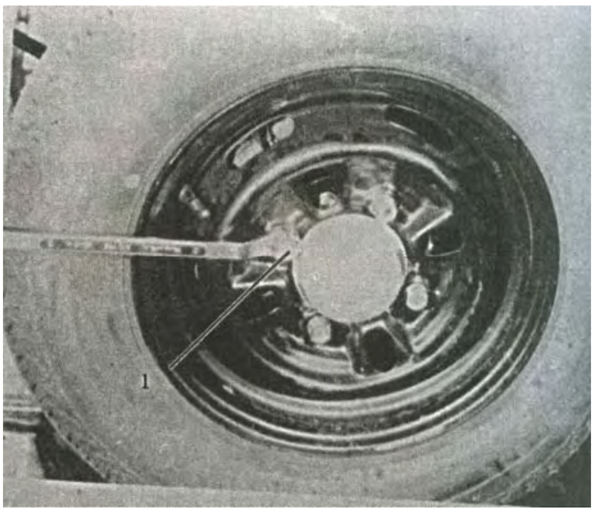


FIG.16-54 1-Wheel nut

（2）Assemble components according to the reverse procedure of removal. (FIG.16-50)

CAUTION
when installing brake shoe, do not damage wheel cylinder cover dust.

（3）Install brake shoe by depressing spring and rotating brake shoe pin. (FIG.16-51)
（4）Adjust the clearance between brake shoe and brake drum to maximum before installing brake drum. Put screwdriver between plate and ratchet wheel and depress ratchet wheel. (FIG.16-52, 16-53)
（5）Install brake drum after cleaning oil and dust on inner surface of brake shoe and brake drum.
（6）Tighten wheel nut to specified torque. (FIG.16-54)

CAUTION
If brake pipe having being disconnected from wheel cylinder，bleed brake system again.

（7）After completing all the works, depress brake pedal with 30kgf load 3~5 times to obtain correct clearance between brake shoe and brake drum.
（8）Check and conform brake for no sticky. Fall the vehicle down from elevator after brake being found normal.

16.4 MASTER CYLINDER

- **Removal**

（1） Disconnect “-” cathode from battery.
（2） Clean outside of reservoir.
（3） Take out fluid with a syringe or such.
（4） Remove steering column assembly（refer to correlative group）
（5） Remove multi-dash（Refer to correlative section）
（6） Remove ECU。
（7） Disconnect two brake hoses connecting reservoir from master cylinder.

CAUTION
Do not allow brake fluid to get on painted surface.

（8） Disconnect two brake pipes from master cylinder.
（9） Remove master cylinder mounting nut, then remove master cylinder.

- **Disassembly** (FIG.16-55)

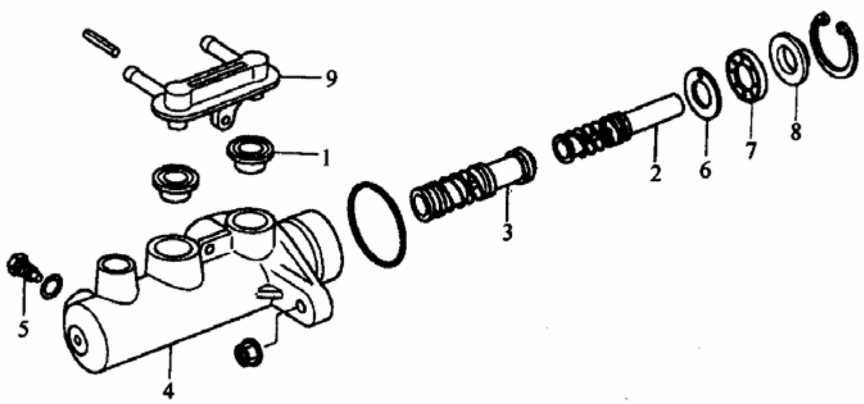


FIG.16-55 1.Seal bush 2. Primary piston assembly 3. Secondary piston assembly 4. Cylinder body 5.Stopper bolt 6.Washer 7.Cup 8.Stopper sealing 9.Pipe fitting

（1）Remove pipe fitting from master cylinder using special tool. (FIG.16-56)

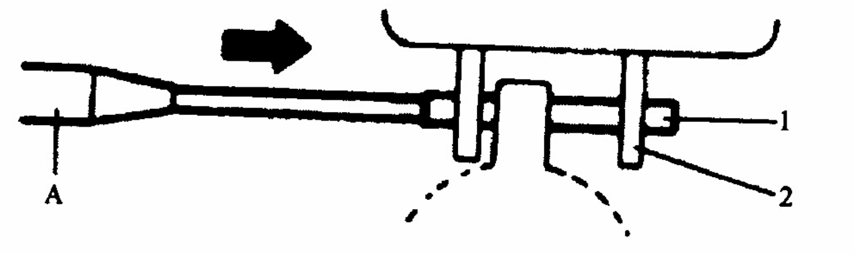


FIG.16-56 1.Spring pin 2. Pipe fitting

（2）Remove circlip using special tool. (FIG.16-57)

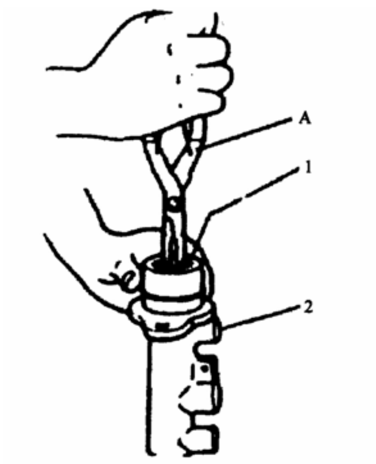


FIG.16-57 1.Circlip 2.Cylinder body

（3）Take out primary piston assembly, pay attention to not make piston fall off. (FIG.16-58)

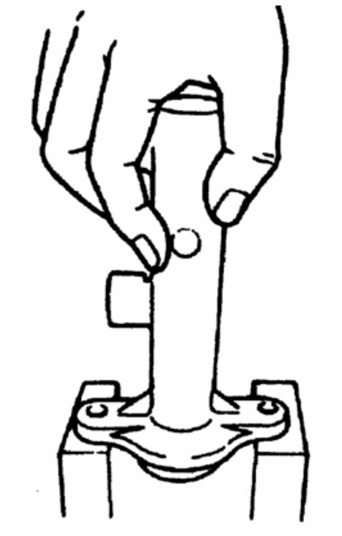


FIG.16-58

（4）Remove piston stopper bolt. Then remove secondary piston assembly. (FIG.16-59)

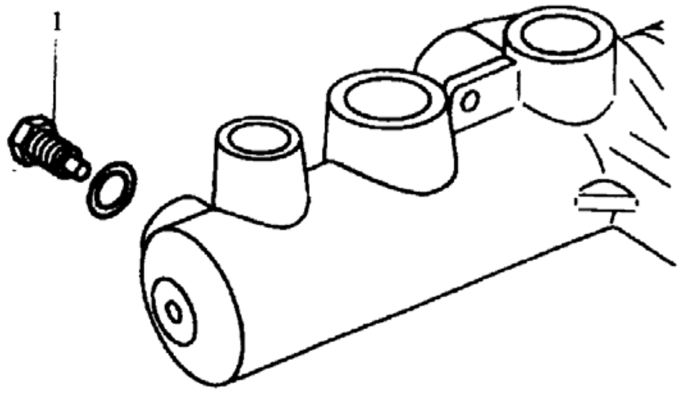


FIG.16-59　　　1.Stopper bolt

- **Parts Inspection**

1）Parts in master cylinder

（1）Inspect all disassembled parts for wear or damage, and replace parts if necessary. (FIG.16-60)。

CAUTION
• Wash disassembled parts with brake fluid.
• Do not reuse piston cups.

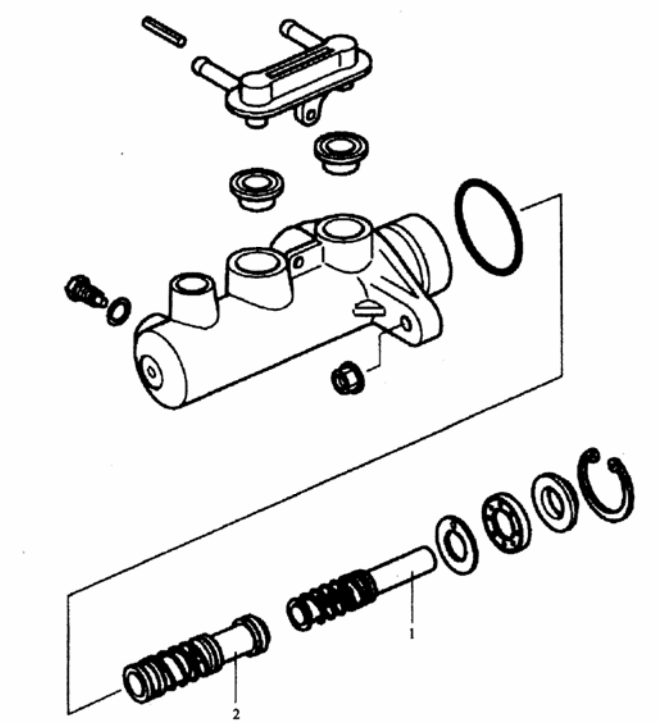


FIG.16-60：1.First piston assembly　2.Second piston assembly

（2）Inspect master cylinder bore for scoring or corrosion. It is best to replace a corroded cylinder. Corrosion can be identified as pits or excessive roughness.

CAUTION
Polishing the bore of the master cylinder with the cast aluminum body with anything abrasive is prohibited, as damage to the cylinder bore may occur.
Rinse cylinder in clean brake fluid. Shake excess rinsing fluid from cylinder. Do not use a cloth to dry cylinder, as lint from cloth can not be kept from cylinder bore surfaces

2） Reservoir

CAUTION

Do not use shock absorber fluid or any other fluid which contains mineral oil. Do not use a container which has been used for mineral oil or a container which is wet from water. Mineral oil will cause swelling and distortion of rubber parts in the hydraulic brake system and water will mix with brake fluid, lowering the fluid boiling point. Keep all fluid containers capped to prevent contamination.

Fluid to fill reservoir with is indicated on reservoir cap of the car with embossed letters or in owner's manual supplied with the car. Add fluid up to MAX line.

- **Assemble**

CAUTION

- Before assembling, wash each part in fluid recommended to use for the car.
- Replace new cup.

（1）Install secondary piston assembly into cylinder according to right direction. Install stopper bolt, and tighten to specified torque shown in FIG.16-61,16-62.

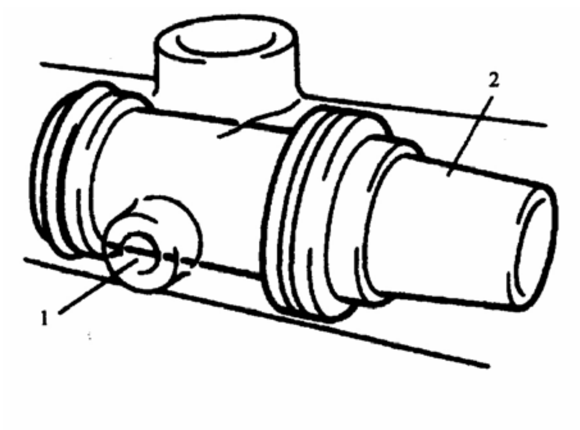


FIG.16-61 1. Stopper bolt 2.Sealing

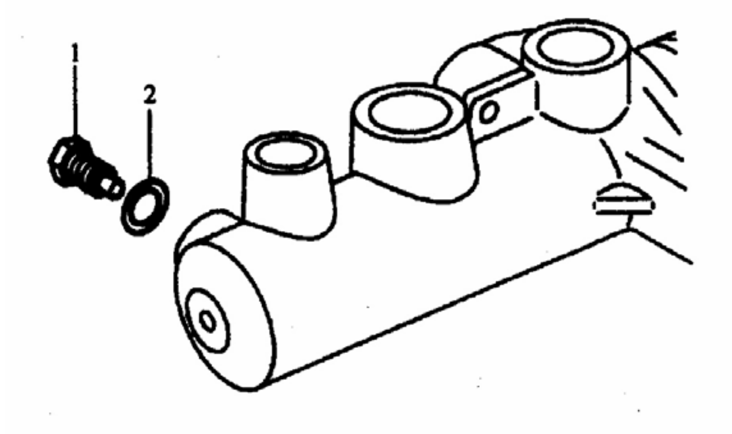


FIG.16-62 1.Stopper bolt screw hole 2.Secondary

TABLE16-8

Part	N • m	kgf • m
Bolt	9~11	0.9~1.1

（2）Install primary piston, washer, cup and stopper sealing .When installing circlip, use special tool. (FIG.16-57)

CAUTION
Install clip into master cylinder groove reliably.

（3）install seal bush and pipe fitting, and install spring pin using special tools. (FIG.16-63)

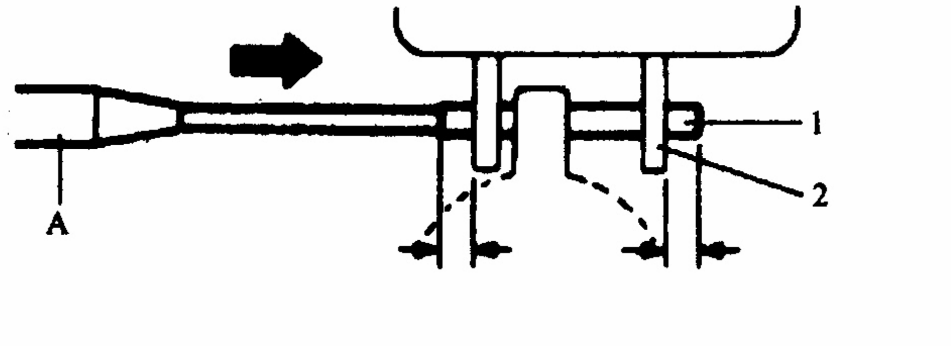


FIG.16-63 1.Spring pin 2. Pipe fitting

（4）Install master cylinder on vehicle.

- **Install Point**

CAUTION
See Caution at the beginning of this section.
Adjust clearance between booster piston rod and primary piston with special tool.
The O ring between brake master cylinder and booster is for sealing. If damaged, the booster will disable. It is necessary to replacing a new part.

It is the reverse procedure of removal and pay attention to the followings：

（1） Install master cylinder on booster and torque attaching nuts to specification. (TABLE16-9)

TABLE 16-9

Parts	N • m	kgf • m
Connecting nut between master cylinder and booster	8~12	0.8~1.2

CAUTION
Be sure not to clip wiring when installing parts.

(2) Connect clutch cable to pedal and adjust clutch pedal play.（Refer to correlative section）
(3) Connect two brake pipes and torque flare nuts to specification.
(4) Connect two hoses to master cylinder, then clip with clamp.
(5) Ensure if all the parts connecting with booster are reliable.
(6) Ensure that all the removed or disconnected parts have been reinstalled or connected to pedal bracket.
(7) Install dash board assembly.（Refer to correlative section）
(8) Install steering column.（Refer to correlative section）
(9) Ensure that all the removed parts have been installed accurately. Adjust if necessary.
(10) After all the part being installed， fill reservoir with specified brake fluid and bleed air from system.
(11)Check lamps and switches for normal work.
(12) Check brake pedal height and play and check leakage.

16.5 BOOSTER

- **Removal**

（1） Remove master cylinder refer to steps（1）~（9）of master cylinder removal.
（2） Disconnect vacuum hose from booster.
（3） Remove vacuum pipe from brake pedal bracket.

（4）　Remove clutch cable.（Refer to correlative section）

（5）　Remove wiring from brake lamp switch.

（6）　Check if there are other parts connecting to pedal bracket, remove if necessary.

（7）　Remove pedal bracket mounting bolt and nut from front room，then remove pedal bracket with booster. Remove B-pin and split pin connecting booster push rod crevice to pedal arm, then remove booster attaching nuts. Take down booster from pedal bracket. (FIG.16-64)

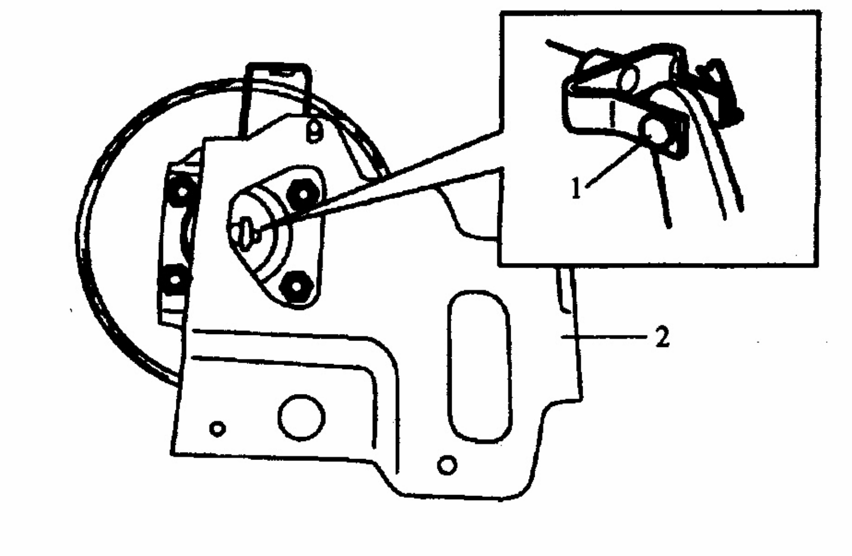


FIG.16-64　　1. Pedal bracket assembly 2. Split pin

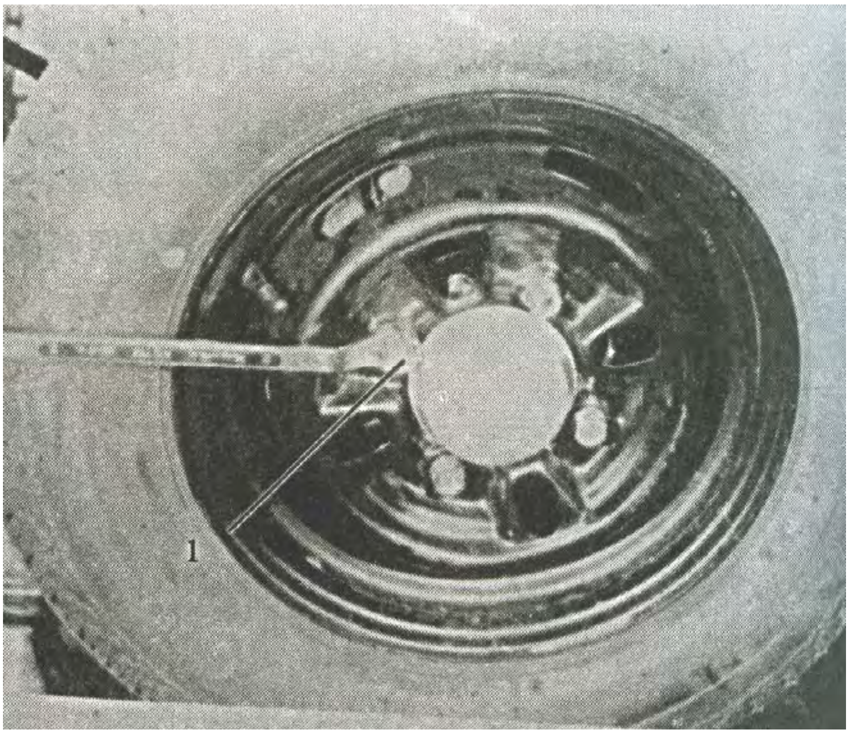


FIG.16-65　　1- Wheel nut

- **Installation**

CAUTION
• See Caution at the beginning of this section. • Adjust clearance between booster piston rod and master cylinder piston with special tool. • Check length of push rod clevis.(FIG.16-65)

（1） Install booster to dash panel. Then connect booster push rod crevice to pedal arm with pin and split pin. (FIG.16-64) Torque booster attaching nuts to specification. (TABLE16-10)

TABLE 16-10

Parts	N • m	kgf • m
Booster attaching nuts	11~17	1.1~1.7

（2） Install pedal bracket on body, and tighten mounting bolt and nut to specified torque. (Tabel16-11)

TABLE16-11

Parts	N • m	kgf • m
Pedal bracket mounting bolt	20~26	2.0~2.6
Pedal bracket mounting nut	20~26	2.0~2.6

（3） Install vacuum pipes.

（4） Install vacuum hose, and ensure clamp with clip.

（5） The other procedures can refer to “ brake master cylinder installation”.

16.6 BRAKE HOSE AND PIPE

●Removal and installation

（1）Take out fluid with a syringe or such.

（2）Clean dirt and foreign material from both hose end or pipe end fittings. Remove brake hose or pipe

（3）Reverse procedure for brake hose installation . When installing brake hose, make sure that it has no twists or kinks. Inspect to see that hose doesn’t make contact with any part of suspension.Checkin extreme right and left turn conditions. If hose makes any contact, remove and correct. Fill and maintain brake fluid level in reservoir. Bleed brake system.

CAUTION
Connect hose to caliper, and tighten to specified torque. After making sure that the hose is installed to right location, fix them with clamps.

16.7 TIGHTEN ING TORQUE

TABLE 16-12

Tightening Parts	N • m	kgf • m
Front brake bleeding bolt	7~9	0.7~0.9
Rear brake bleeding bolt	7~10	0.7~1.0
Brake pipe flare nut	15~18	1.5~1.8
Fitting mounting nut	10~12	1.0~1.2
Proportion valve bolt	10~12	1.0~1.2

CAUTION

- Be sure to install E-clip in brake hose groove. (FIG.16-66)
- After installing, depress brake pedal to check for leakage .

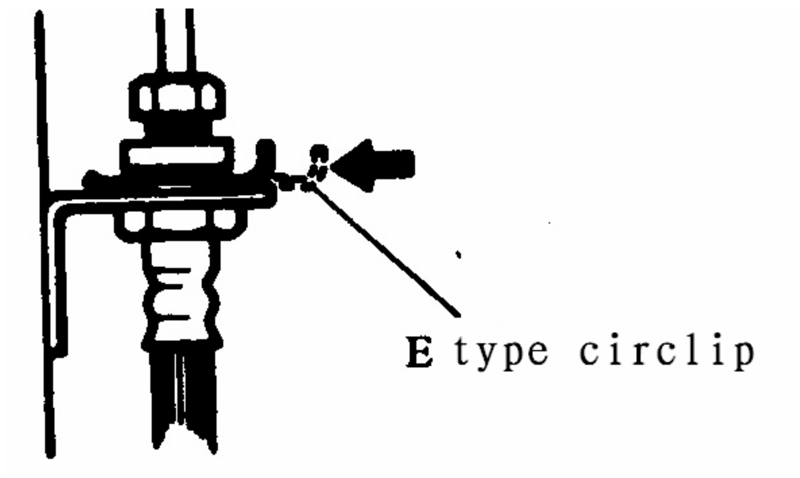


FIG.16-66

16.8 SERVICE

● Brake System Road Test

The brake system road test should be carried on a dried, cleanly, planar, horizontal road. When testing , depress brake pedal slightly or heavily at different speed to check for brake deviation, If brake deviation is founded, check tire pressure, front wheel alignment, front suspension looseness， and check other reason in diagnose table.

1）Brake Fluid Leakage

Check the fluid lever. If the fluid lever decrease slightly, the cause may be pad lining wear. When fluid decreases quickly, inspect brake system for leakage. Even if the leakage is slightly， connecting or replacing is necessary.

2）Brake Fluid Level Inspection

（1） Be sure to use brake fluid recommended in owner’s manual which comes along with that car.

（2） Use of any other fluid is strictly prohibited.

（3） Fluid level should be between MIN and MAX lines marked on reservoir.

（4） When warning light lights sometimes during driving, replenish fluid to MAX line.

（5） When fluid decreases quickly, inspect brake system for leakage. Correct leaky points and then refill to specified level.

3）Fill Brake Fluid into Reservoir.

CAUTION

Do not use shock absorber fluid or any other fluid which contains mineral oil. Do not use a container which has been used for mineral oil or a container which is wet from water.

Mineral oil will cause swelling and distortion of rubber parts in the hydraulic brake system and water will mix with brake fluid, lowering the fluid boiling point. Keep all fluid containers capped to prevent contamination. Fill brake fluid into reservoir according to owner’s manual which comes along with that car.

Add brake fluid to the MAX line.

4）Brake Pedal Free Height Adjustment

The brake pedal height is normal if the brake pedal is as high as the clutch pedal.

（1） When the booster push rod crevice has been reinstalled, it is important that the measurement between the booster mounting surface and the center of the crevice pin hole is adjusted within 到 99.5~100.5mm.

（2） When the stop light switch has been removed, refer to the following STOP LIGHT SWITCH ADJUSTMENT for proper installation.

The services in above steps（1） and （2）may affect the brake pedal height.

5）Stop Light Switch Adjustment

Adjustment should be made as follows when installing the switch.：

Pull up brake pedal toward you and while holding it there, adjust the switch position so that clearance between the end of thread and brake pedal contact plate is within 0.5~1.0mm. Then tighten the lock nut to specified torque. (FIG.16-67)

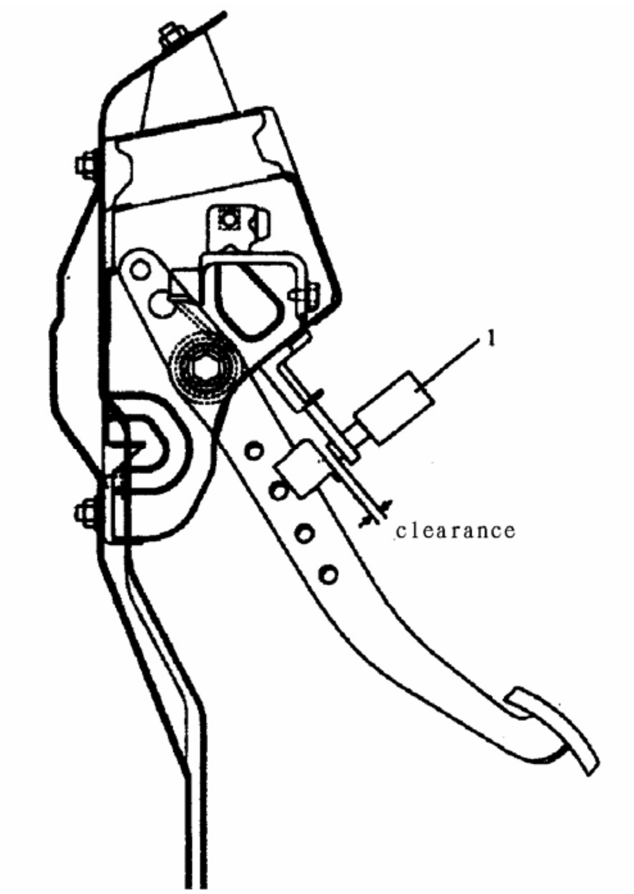


FIG.16-67 1.Brake Lamp switch

6） Pedal Travel Check

CAUTION

- Start the engine.
- Depress brake pedal a few times.
- With brake pedal depressed with approximately 30kgf load, measure pedal arm to wall clearance “B”. It must not be less than 145mm.(FIG.16-68)

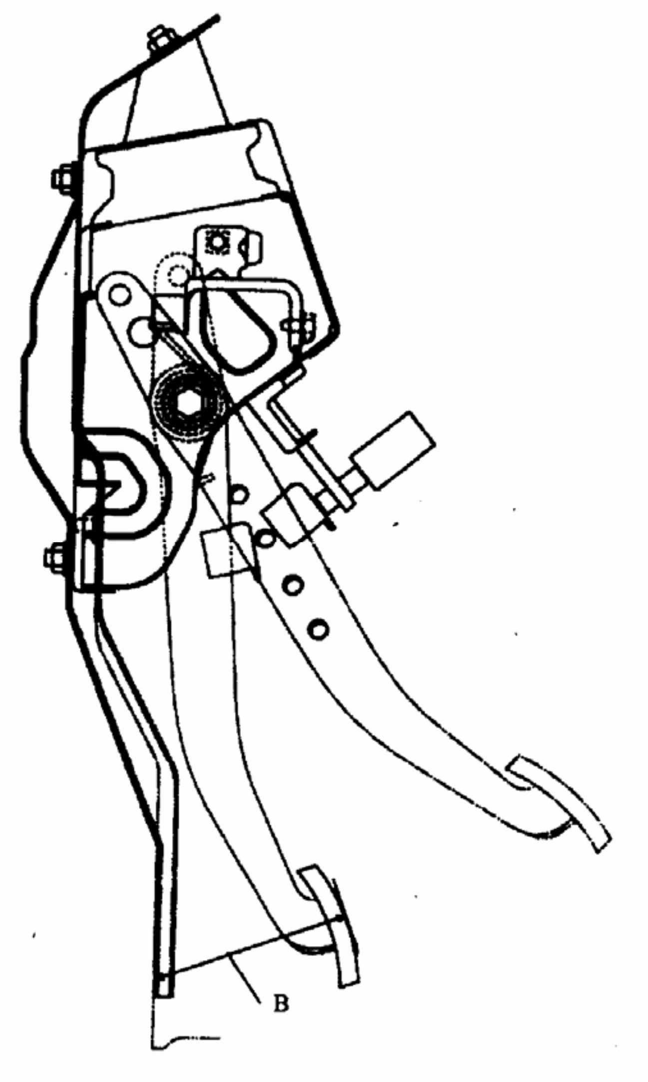


FIG.16-68

When measuring, roll up carpet and others below pedal.

If clearance “B” is less than 145mm, the most cause is either rear brake shoe are worn out beyond limit or air is in lines.

Should clearance “B” is less than 145mm even after replacement of brake shoes and bleeding of system, other possible but infrequent cause is malfunction of the brake shoe adjusters or booster push rod length out of adjustment for the vehicle with brake booster.

① Brake shoe inspection;

② Bleeding brake system;

③ Remove brake drums for adjuster inspection, If defective, correct or replace.

- **Brake Hose And Brake Pipe Inspection**

1）Brake hose

The flexible hydraulic brake hose, which transmits hydraulic pressure from the steel brake line on the body to the rear cylinders and to the front calipers, should be inspected at least twice a year. The brake hose assembly should be checked for road hazard damage, for cracks and chafing of the outer cover, for leaks and blisters. A light and mirror may be needed for an adequate inspection. If any of the above conditions are observed on the brake hose. It will be necessary to replace it.

2）Brake pipe

Inspect the tube for damage, cracks, dents and corrosion. If any defect is fount, replace it.

- **Pad Lining Inspection**

Inspect pad lining periodically according to maintenance schedule and whenever wheels are removed.

1）Brake disc inspection

Inspect periodically according to maintenance schedule

2）Brake shoe and pad lining inspection

Inspect periodically according to maintenance schedule

3）Brake drum inspection

Inspect periodically according to maintenance schedule

- **Parking Brake Inspection And Adjustment**

1）Parking brake lever travel inspection and adjustment

（1） Pull parking brake lever with the force of 20kgf and count the notch，which should be within the specified area，TABLE16-13。

CAUTION
When inspecting, pull parking brake lever strictly with the force of 20kgf.

TABLE16-13

Notches of lever travel、20kgf	Standard
	8~11notchs

（2） If the parking brake lever does not have the specified travel, adjust according to the following method:

① Loosen adjust nut，and keep parking brake cable free.(FIG.16-69)

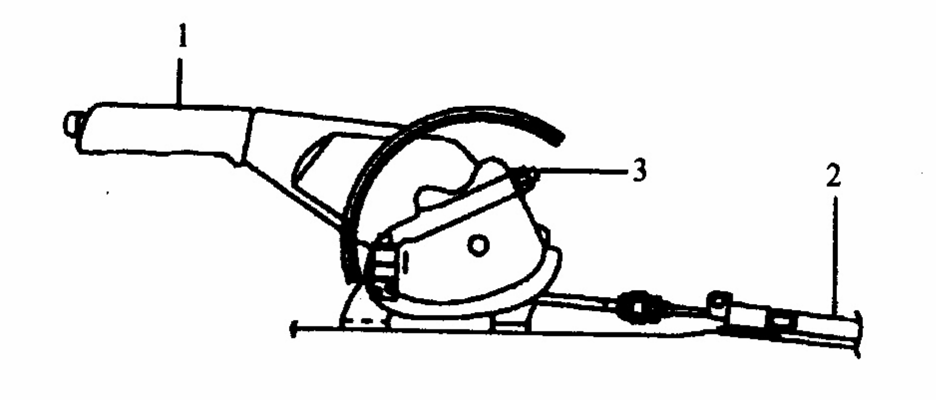


FIG.16-69 1.Parking brake lever 2.Parking brake cable 3.Adjust nut

② With the engine idling，depress brake pedal 3~5 times and make sure that pedal travel doesn’t change.

Note：If pedal travel doesn’t change, that means the self-adjusting function is normal and the clearance between brake shoe and brake drum is right.

③ Adjust adjust nuts so as t o make the paring brake lever travel within standard value. After adjusting, check if there is clearance between adjust nut and parking brake lever.

Check if adjust nut has been fixed by nut seat.

CAUTION
If parking brake lever travel is less than standard value, which means parking brake is tight, rear brake will drag.

④ After adjusting parking brake lever travel, jack up the rear of the vehicle. Release parking brake lever and rotate rear wheel to confirm rear brake without dragging.

2）Parking brake switch inspection
（1）removal central control box.
（2）check continuous between parking brake switch terminal and switch bolt.(FIG.16-70)
-

Parking brake cable is been pulled up	Continuous
Parking brake cable is been released	No continuous

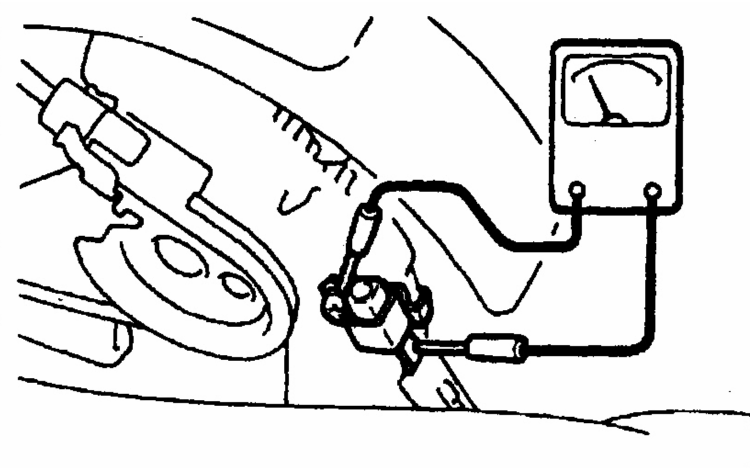


FIG.16-70

- **Brake Pedal Play Check**

Pedal play should be within specification in FIG.16-71. If out of specification, check stop light switch for proper installation and adjust if necessary. Also check pedal shaft bolt and master cylinder pin installation for looseness and replace if defective.。

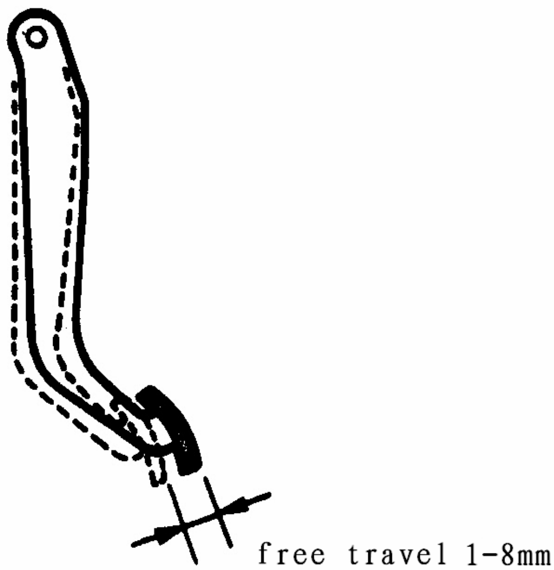


FIG.16-71

- **Brake Fluid Level Sensor Check**

Connect an ohmmeter between the sensor connector terminals. The brake fluid level sensor is in good condition if there is no continuity when the float surface is above “MIN” and if there is continuity when the float surface is below “MIN”.

- **Stop Lamp Switch Inspection**

（1）Connect an ohmmeter between the stop lamp switch connector terminals.

（2）There should be no continuity between the terminals when the plunger is pushed in as shown in FIG.16-72. There should be continuity when it is released.

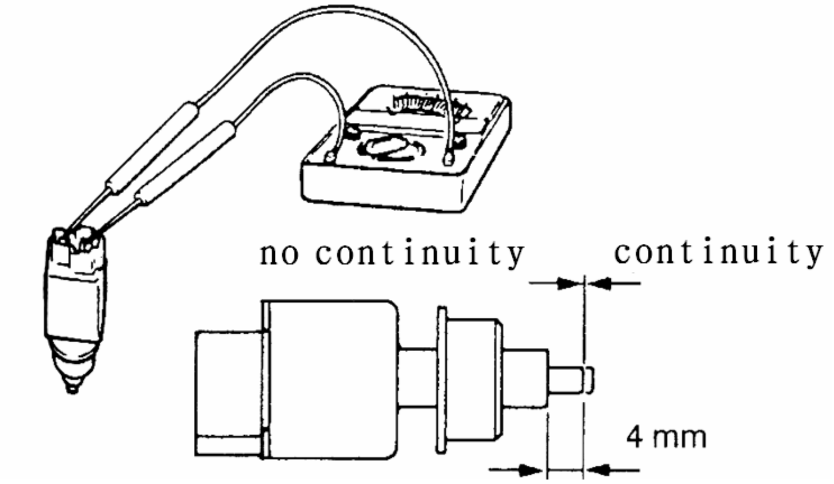


FIG.16-72

- **Rear Brake Adjustment**

Rear brake has self-adjusting mechanism but it does require adjustment for proper drum to shoe clearance when brake shoe has been replaced or brake drum has been removed for some other service.

Adjustment is automatically accomplished by depressing brake pedal 3~5 times with approximately 30kgf load after all parts are installed.

Check brake drum for dragging and brake system for proper performance. After lowering car from lift, brake test should be performed.

- **Flushing Brake Hydraulic System**

It is recommended that the entire hydraulic system be thoroughly flushed with clean brake fluid whenever new parts are installed in the hydraulic system. It is recommended that the brake fluid is replaced every two years periodically.

CAUTION

Brake fluid is extremely damaging to paint. If fluid should accidentally touch a painted surface, immediately wipe fluid from paint and clean the painted surface.

Bleeding brakes：

A bleeding operation is necessary to remove air whenever it is introduced into the hydraulic brake system.

Bleeding operation should be performed at following conditions：

a）Brake reservoir or hose being disassembled；
b）brake master cylinder being disassembled；
c）joint part being removed；
d）proportion being disassembled；
e）after brake fluid replaced；
f）When air entering into brake system.

CAUTION

Perform bleeding operation starting with wheel cylinder furthest from master cylinder .

（1） Fill master cylinder reservoir with brake fluid and keep at lease one-half full of fluid during bleeding operation.

（2） Remove bleeder plug cap. Attach a vinyl tube to the bleeder plug of wheel cylinder, and insert the other end into a container.FIG16-73。

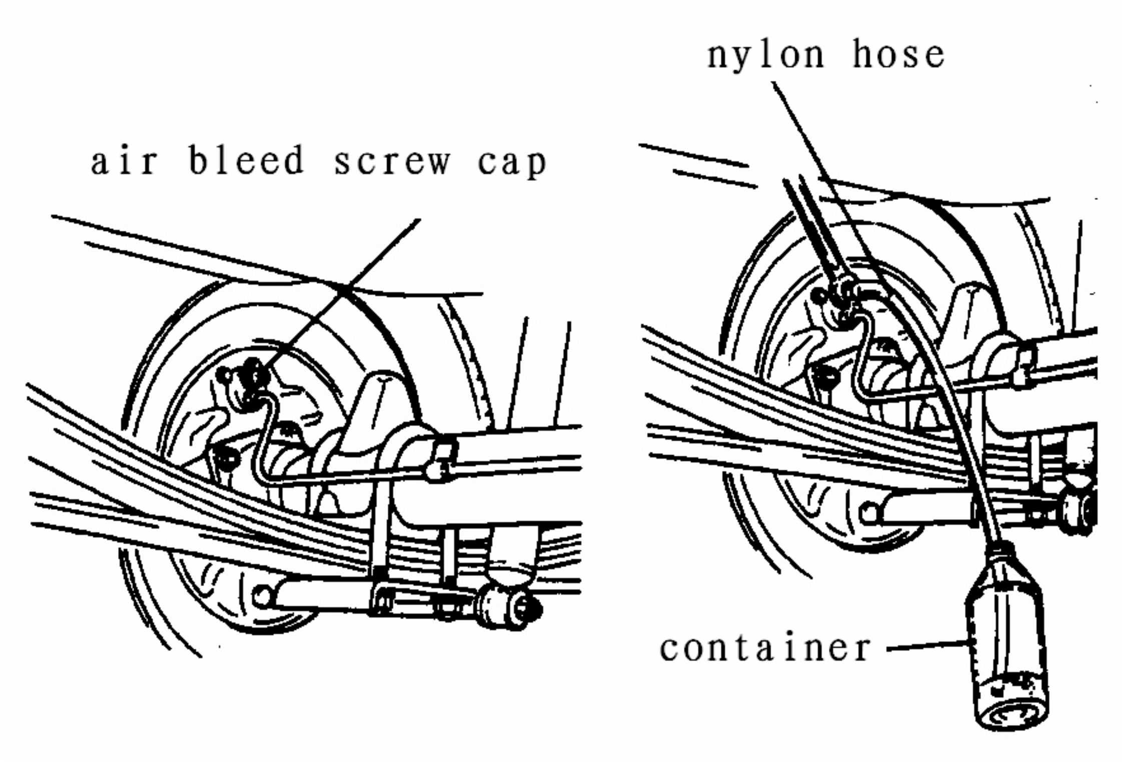


FIG16-73

（3） Depress brake pedal several times, and then while holding it depressed, loosen bleeder plug about one-third to one-half turn. FIG 16-74。

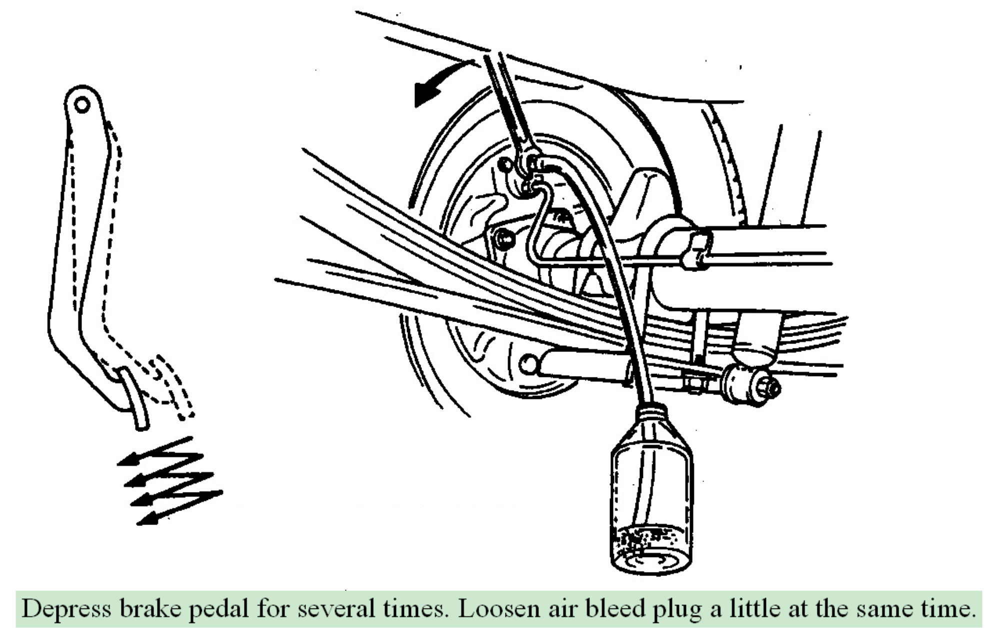


FIG 16-74

（4） When the fluid pressure in the cylinder is almost depleted, retighten the bleeder plug. FIG16-75。

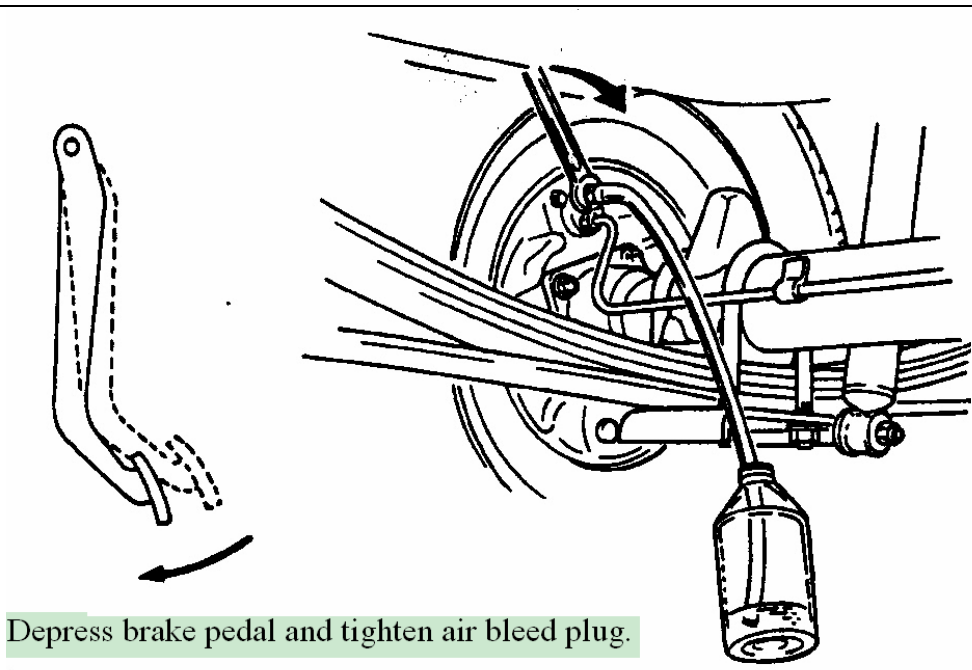


FIG16-75

（5） Repeat this operation until there are no more air bubbles in hydraulic line.

（6） When bubbles stop, depress and hold brake pedal and tighten bleeder plug.（TABLE16-11）。

（7） Then attach bleeder plug cap. FIG16-76。

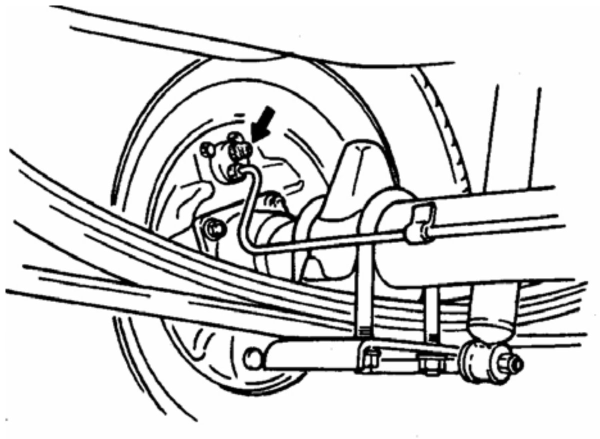


FIG16-76

（8） After completing bleeding operation, apply fluid pressure to pipe line and check for leakage.

（9） Replenish the fluid in the reservoir to specified level.

（10）Check brake pedal for “sponginess”. If found spongy, repeat entire procedure of bleeding.

- Vacuum hose、Vacuum pipe and proportioning valve inspection

1）Vacuum hose

- Check vacuum hose for road hazard damage, cracks and chafing of the outer cover. A light and mirror may be needed for an adequate inspection. If any of the above conditions are observed on the vacuum hose. It will be necessary to replace it.

2）Vacuum pipe

Inspect the pipe for damage, cracks. If any defect is fount, replace it.

3）Proportioning valve

Proportioning valve is installed in vacuum hose connecting with engine intake manifold. The arrow in vacuum hose should point to intake manifold side.

CAUTION

It is not allowed to take off proportioning valve from vacuum hose. If it is defective,

always replace it as an assembly unit together with the vacuum hose.

Check the operation of the proportioning valve by using a vacuum pump（fig.16-77）, TABLE16-14。

TABLE16-14

Vacuum Pump Connection	Accept/Reject Criteria
Connection at the brake booster side （1）	A negative pressure is created and held.
Connection at the intake manifold side （2）	A negative pressure is not created

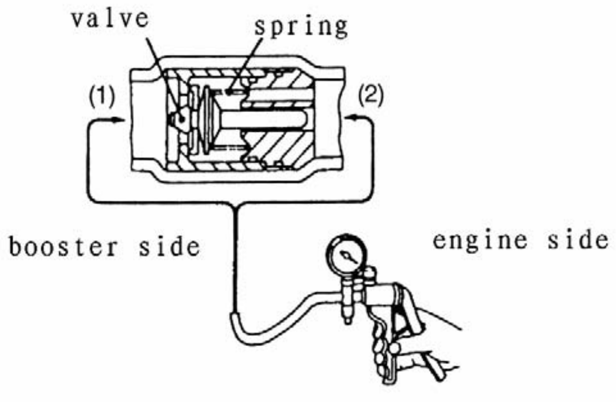


FIG.16-77

The component above may affect operation of booster.

- **Inspect Booster Operation**

There are two ways to perform this inspection, with and without a tester.

CAUTION
● For this check, make sure that no air is in hydraulic line ● Check without using a tester. ● Check air tightness.

（1） Start engine.

（2） Stop engine after running for 1 or 2 minutes.

（3） Depress brake pedal several with the same load as in ordinary braking and ovserve pedal travel. If pedal goes down deep the first time but its travel decreases as it is depressed the second and more times, air tightness is obtained (FIG.16-78)

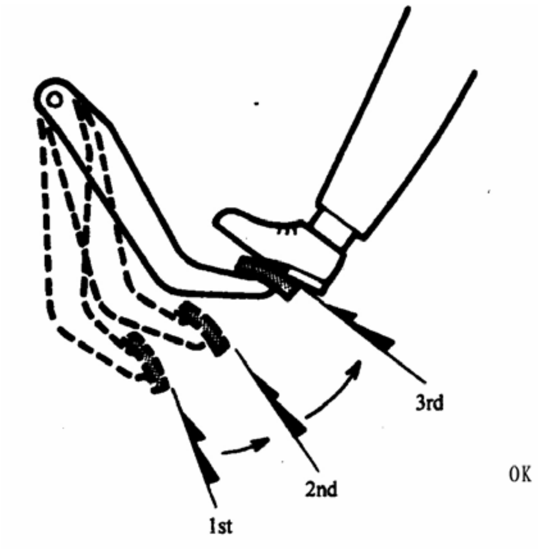


FIG.16-78

（4） If pedal travel doesn't change， air tightness isn't obtained. (FIG.16-79)

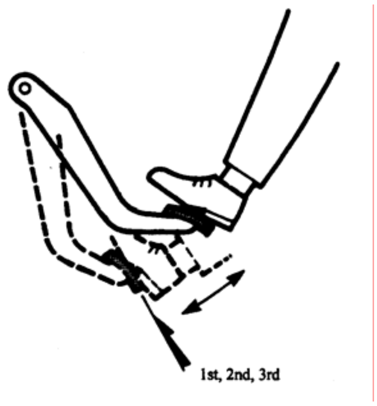


FIG.16-79

CAUTION
If defective, inspect vacuum lines and sealing parts, and replace any faulty part.

- **Check Operation**

（1） With engine stopped，depress brake pedal several times with the same load and make sure that pedal travel doesn't change. (FIG.16-80)

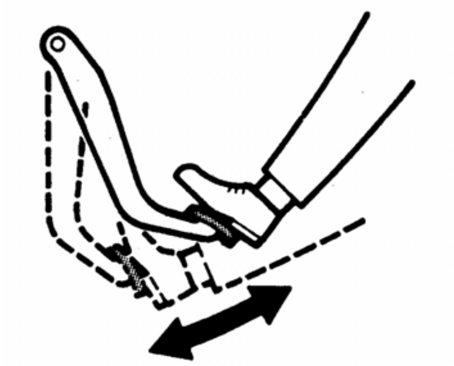


FIG.16-80

（2） Start engine while depressing brake pedal, If pedal travel increases a little, operation is satisfactory. But no change in pedal travel indicates malfunction. (FIG.16-81)

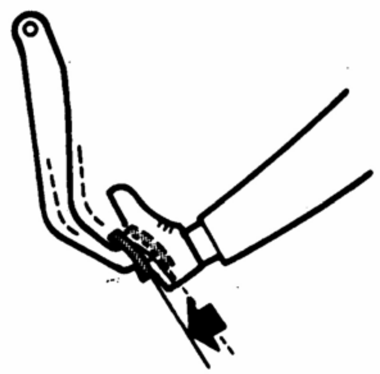


FIG.16-81

Check air tightness under load：

（1） With the engine running， depress brake pedal. Then stop engine while holding brake pedal depressed.

（2） Hold brake depressed for 30s. If pedal height does not change, condition is good. But is isn't if pedal rises. (FIG.16-82)

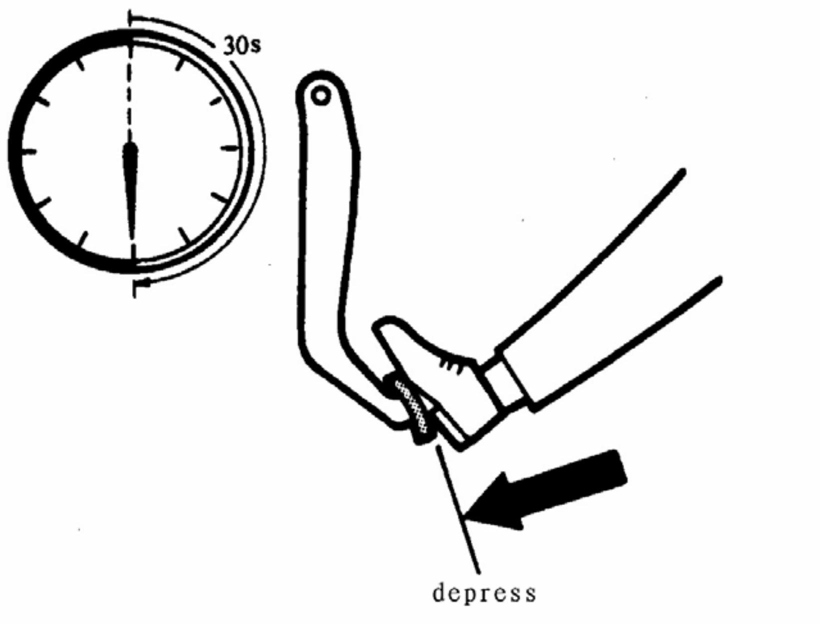


FIG.16-82

17 BODY ELECTRICAL SYSTEM

17.1 AUDIO

- **GENERAL DESCRIPTION**

Audio used in the vehicle consists of one main unit, one antenna and four speakers,. The antenna is installed at the rear of roof; tow speakers are fitted on front side of instrument, the other tow speakers are fixed on both side panels

- **DIAGRAM**(Fig. 17-1)

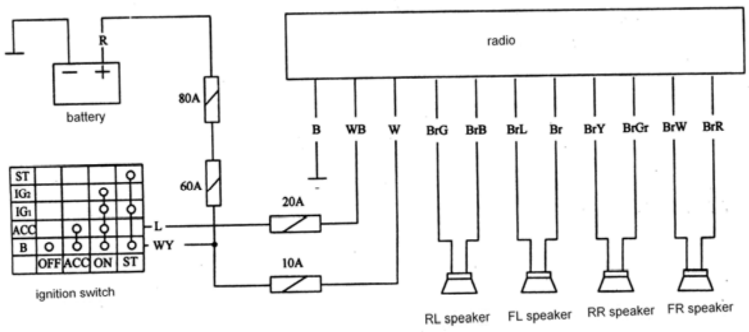


Fig.17-1

- **SERVICE**

CAUSES AND REMEDY（see Table 17-1）

Table 17-1

Noise type sounds are in parentheses()	Conditions	Cause	Remedy
AM、FM: Ignition noise (Popping, snapping, cracking, buzzing)	•Increasing the engine speed causing the popping sound to speed up, and volume decrease. •Disappears when the ignition switch is turned to ACC.	•Mainly due to the spark plugs. •Due to the engine noise	•Check or replace the earth cable and earth bolts. •be sure that the radio is installed steadily.
AM、FM: Wiper motor noise (ululating)	The noise is synchronic with the wiper operation. Increasing the wiper speed causes the noise to speed up. Disappear when the wiper stops.	•Due to sparks on the wiper motor brushes	•Replace wiper motor.
Other electrical components	—	•Noise may appear as electrical components become older.	Repair or replace electrical components
Static electricity (Cracking, crinkling)	•Disappears when the vehicle is completely stopped.	Occurs when parts or wiring move for some reason and contact metal parts of the body	Return parts or wiring to their proper position.

	Various noises are produced depending on the body part of the vehicle	Due to detachment from the body of the front pedal, trunk, bumpers, exhaust pipe and muffle, suspension, etc.	Tightening the mounting bolts securely. Cases where the problem is not eliminated by a single response to on area are common, due to several body parts being imperfectly earthed
Tape player • Ignition noise (Cracking) • Current noise (Crinkling)	The noise can be heard clearly during music pause when playing tape.	Due to wire harness on back of audio.	Keep a distance between body wire harnesses and audio harness.

CAUTION

(1) Check that there is no external noise. Since failure caused by this may result in misdiagnosis due to inability to identify the noise source, this operation must be performed.
(2) Noise prevention should be performed by suppressing strong sources of noise step by step.
(3) Be sure that earth lead and antenna is connected securely.

17.2 CLUSTER METER

1 COMBINATION METER

- **DIAGRAM**（Fig.17-2）

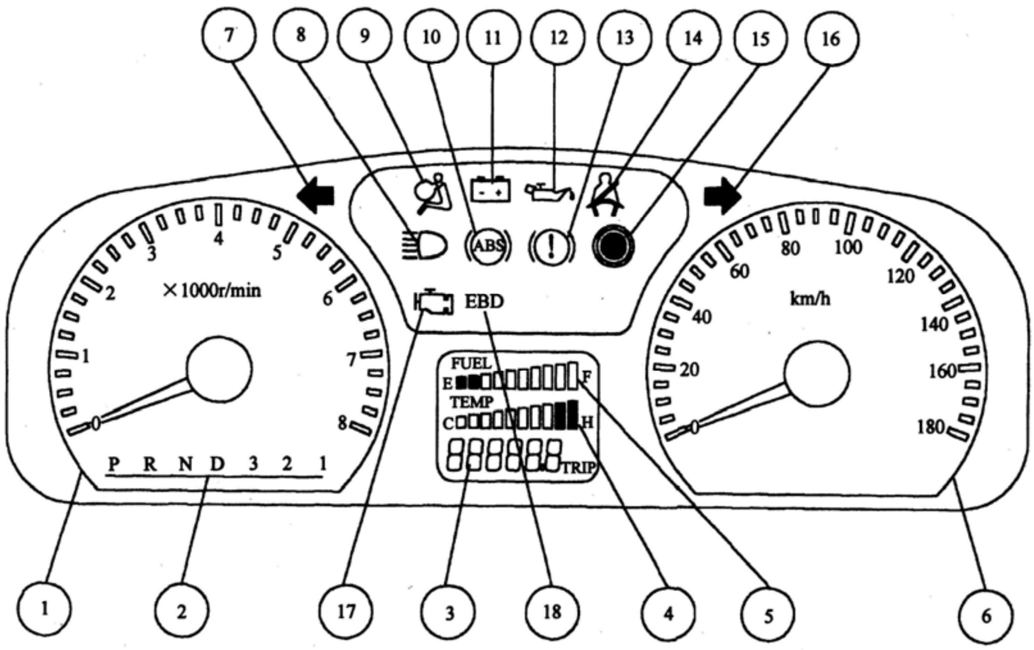


Fig. 17-2

1—Speedometer 2—A/T indicator lights 3—Odometer/Trip mileage meter 4—Water temperature meter 5—Fuel level meter 6—Tachometer 7—Left turn indicator 8—Beam 9—SRS warning lamp 10—ABS warning lamp 11—Charging indicator 12—Oil pressure warning lamp 13—Brake level/park brake warning lamp 14—Belt warning lamp 15—Immobilizer indicator 16—Right turn indicator 17- Engine service indicator 18—EBD indicator (optional)

- **CIRCUIT DIAGRAM OF THE COMBINATION METER**（Fig. 17-3）

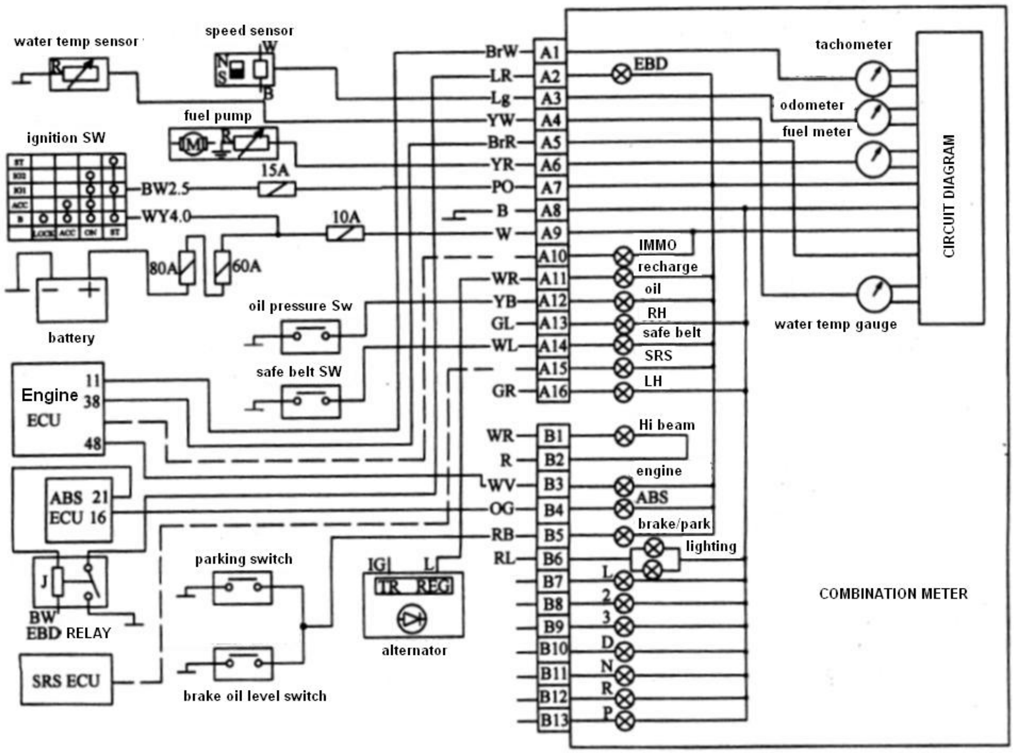


Fig.17-3

2. WATER TEMPERATURE METER AND GAUGE UNIT

- **GENERAL DESCRIPTION**

The water temperature meter located in the combination meter, and the gauge unit is fitted on the engine water out hose.

The gauge unit shows different resistance values depending on the coolant temperature. and the CPU in combination meter receives the signal, and light the strap corresponded with the resistance value and straps before on LCD screen. So resistance value of the gauge unit decreases as coolant temperature rises, and straps lighted one by one, and indicate that water temperature moves to ‘ H ‘ from ‘C’.

- **SERVICE**

1）TROUBLESHOOTING FOR WATER TEMPERATURE METER

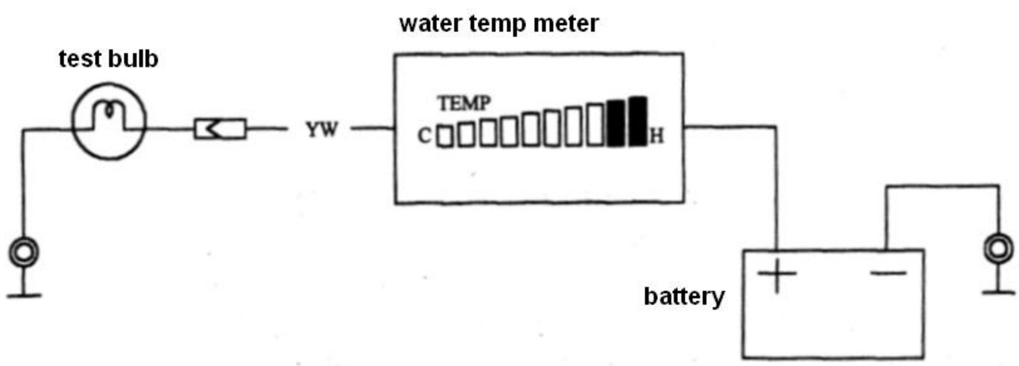


Fig. 17-4

- Disconnect YW lead wire going to the gauge unit.
- Use a bulb（12V，3.4W）in position to ground lead above, as shown in Fig. 17-4.
- Turn ignition switch ON.

- Confirm that the bulb is lighted with the meter indicating to ‘H’.
  If not, the meter is damage, replace the meter.

2）TROUBLESHOOTING FOR WATER TEMPERATURE GAUGE UNIT

Warm up the gauge unite as shown in Fig.17-5. Thus make sure that the resistance is decreased with the increase of temperature. The temperature and resistance relationship can be plotted in table as show in Table 17-2. If not, the gauge unite is damage, replace the gauge unite.

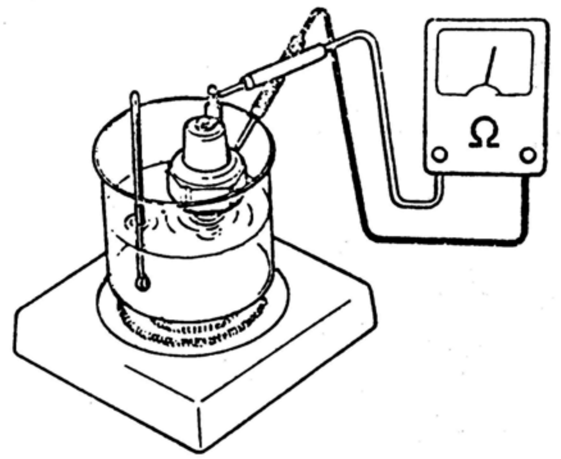


Fig. 17-5

Table 17-2

Temperature（℃）	64	115
Basic resistance（Ω）	89±10	$18.3_{-1.6}^{+1.9}$

3 FUEL LEVEL METER AND GAUGE UNIT

- **GENERAL DESCRIPTION**

The gauge unit shows different resistance values depending on location of the float position. The CPU in the meter receives the resistance signal and light the strap corresponding to the resistance and the strap below. The resistance reduces with the float rising, and the straps lighted one by one, indicates that fuel level moves from position ‘ E’ to ‘ F’.

- **SERVICE**

1） TROUBLESHOOTING FOR FUEL LEVEL METER

- Disconnect the YR lead going to the gauge unit.
- Use a bulb (12V, 3.4W) in position to ground the above, as shown in Fig. 17-6.
- Turn the ignition switch ON.
- Confirm that the bulb is lighted with the meter pointer pointing to ‘F.
  If the meter is faulty, replace it.

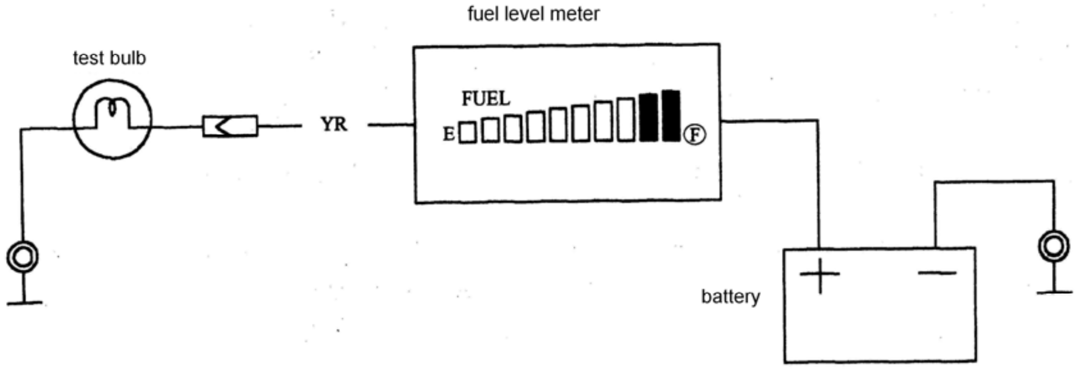


Fig.17-6

2）TOUBLESHOOTING FOR GAUGE UNIT

- Take out the fuel pump from the fuel tank.
- Measure the resistance between the gauge unite, which is on the position of 'E' and 'F', and ground, confirm the values in range of standard values. The resistance value changes smoothly while the float slips slowly between 'E' and "F'.

The standard values see Table 17-3

Table 17-3

position of float	Resistance
F	3±2Ω
E	110±3Ω

17.3 WIPER AND WASHER

1 GENERAL DESCRIPTION

Electric wipers in this vehicle include a front wiper and a rear wiper. The front wiper is installed on front of windshield, which consists of one motor (2-speed type), one link, tow arms and blades. The rear wiper consists of one motor (1-speed type) and one arm and blade.

There are front and rear washers in the vehicle. Nozzles of the front washer is installed on cowl trim, the washer tank is fitted on the firewall. The rear nozzle locates upside right of the tail gate.

Switches of the front wiper and washer are located in the combination switch. The rear ones are fitted on the right of the instrument panel.

2 CIRCUIT DIAGRAM (Fig. 17-7)

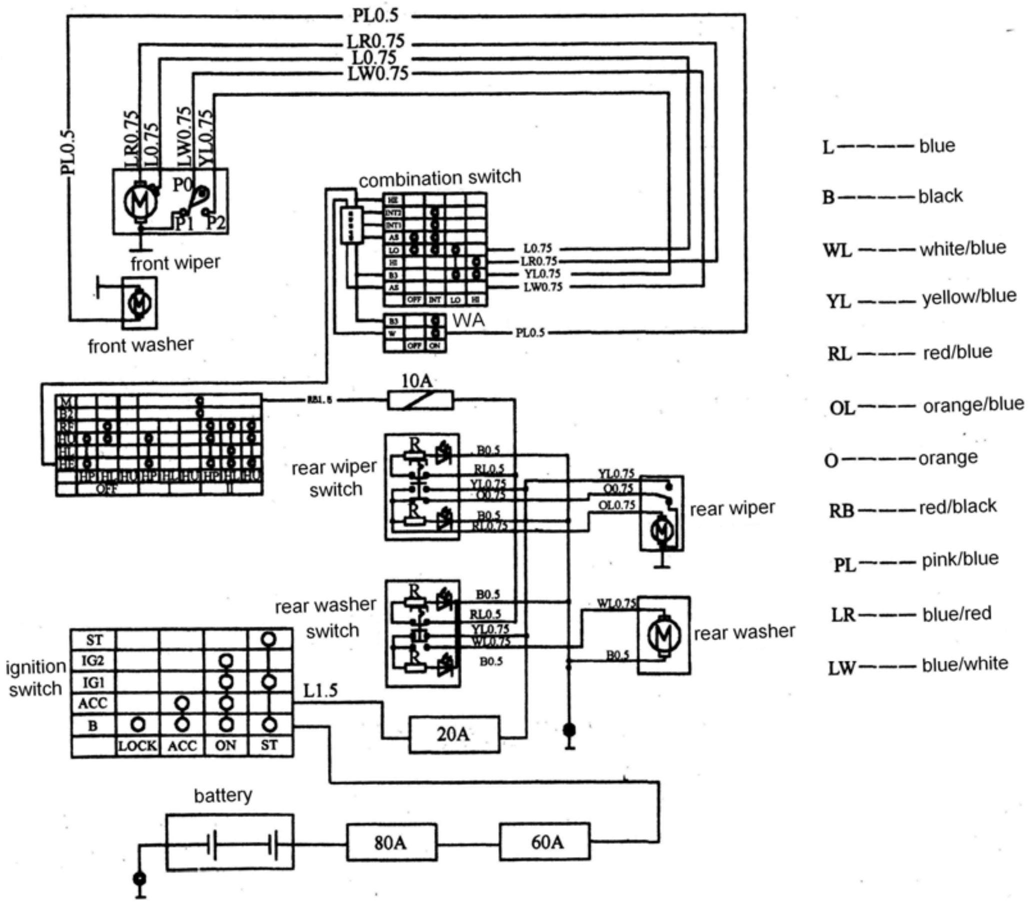


Fig.17-7

Wiper motor is an auto-reset device. When the wiper switch is turned OFF, the blades will return to horizontal places automatically. That is, when wiper switch is turned ON while the ignition switch ON, the motor rotates with current from battery to motor and makes blades swing. It is a gear mechanism that transfers rotation of the motor to swing of blades. There is a cam on the last gear shaft, the cam make the circuit containing the contacts P0, P2 except the reset position. In the reset position the cam break the contacts P0, P2, and make the contacts P0, P1.

While the wiper switch is turned on, no circuit is made the contact P0 with other circuit, so make no effect on the motor rotation. But, when the wiper is turned to 'OFF', and blades is located position other than the reset position, the current route changes (for the front, lead LW - lead L –motor or for the rear lead O –lead LO – motor), so that the motor continues to rotate.

When the blades return the reset position, the cam make connection of the contacts P0, P1, and cut current route of the motor. A reverse electromotive force generates in the armature, so for a reverse current. The current makes a force of the armature in reverse to the rotation direction, which stops the motor. The blades stop on the specified position

3. SERVICE

1）WIPER

Check leads and connectors for continuity if the motor fails to rotate while the wiper switch is turned ON. And then check following items.

① Fuse for blown.

② The wiper switch for continuity.

Disconnect combination switch, or rear wiper & washer switch, check terminals for continuity, using a tester.

Front wiper & washer switch (Fig. 17-8)

Rear wiper & washer switch. (Fig.17-9)

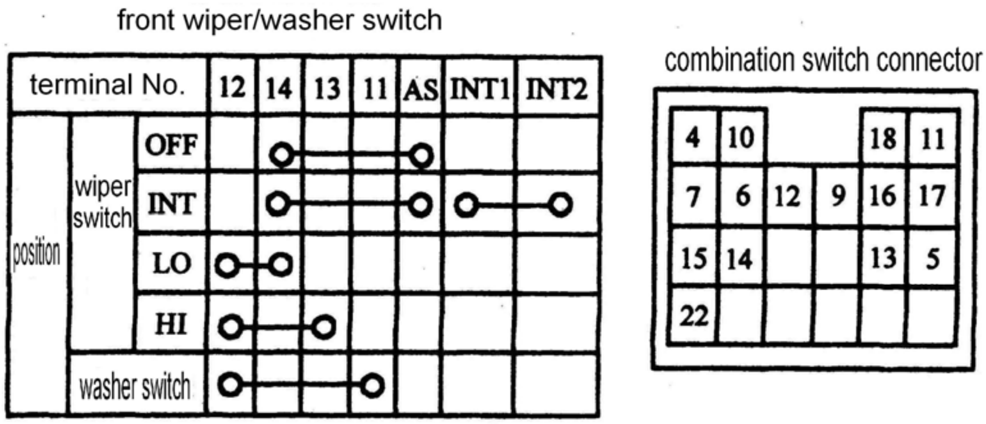


Fig. 17-8

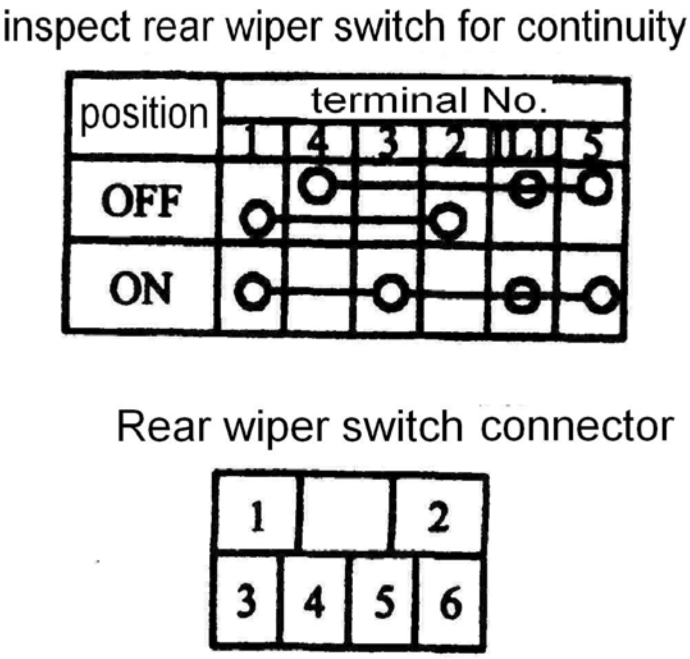


Fig. 17-9

③ Check the wiper motor armature for damage, and commutater brushes for contact condition
Check the front wiper for continuity of terminal 3-ground , terminal 4-ground (Fig.17-10).
Check the rear wiper for continuity of terminal 3-ground (Fig.17-11).

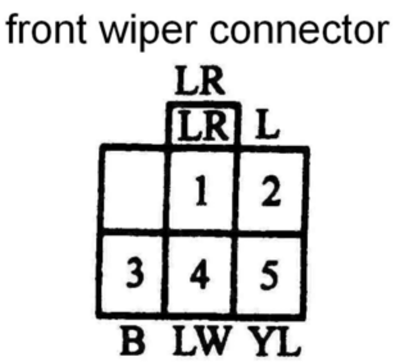


Fig. 17-10

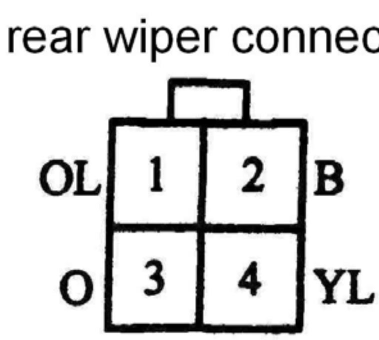


Fig. 17-11

2) **NO-LOAD TEST**

（1） Front wiper

Connect 12V-battery positive pole to terminal 3, and the negative pole to the gear box; the motor should rotate in a speed that ranges from 48 r/min to 60 r/min(low speed); then connect the battery positive pole to terminal 4 and the negative pole to the gear box, the motor should rotate in a speed ranging from 65r/min to 79r/min(high speed).

（2） Rear wiper

Connect the battery positive pole to terminal 3 (shown in Fig. 17-11) and the negative pole to the gear box, the motor should rotate in a speed ranging from 48r/min to 60r/min.

3）**INSPECTION FOR AUTO-RESET**

（1）Front wiper

Connect the battery positive pole to terminal 1 (shown in Fig. 17-10), the negative pole to the gear box and connect terminal 2 to 3 using a jumping lead. Check the motor shaft for returning to the specified position. Check the motor shaft for returning to same position when starting and stop the motor for several times

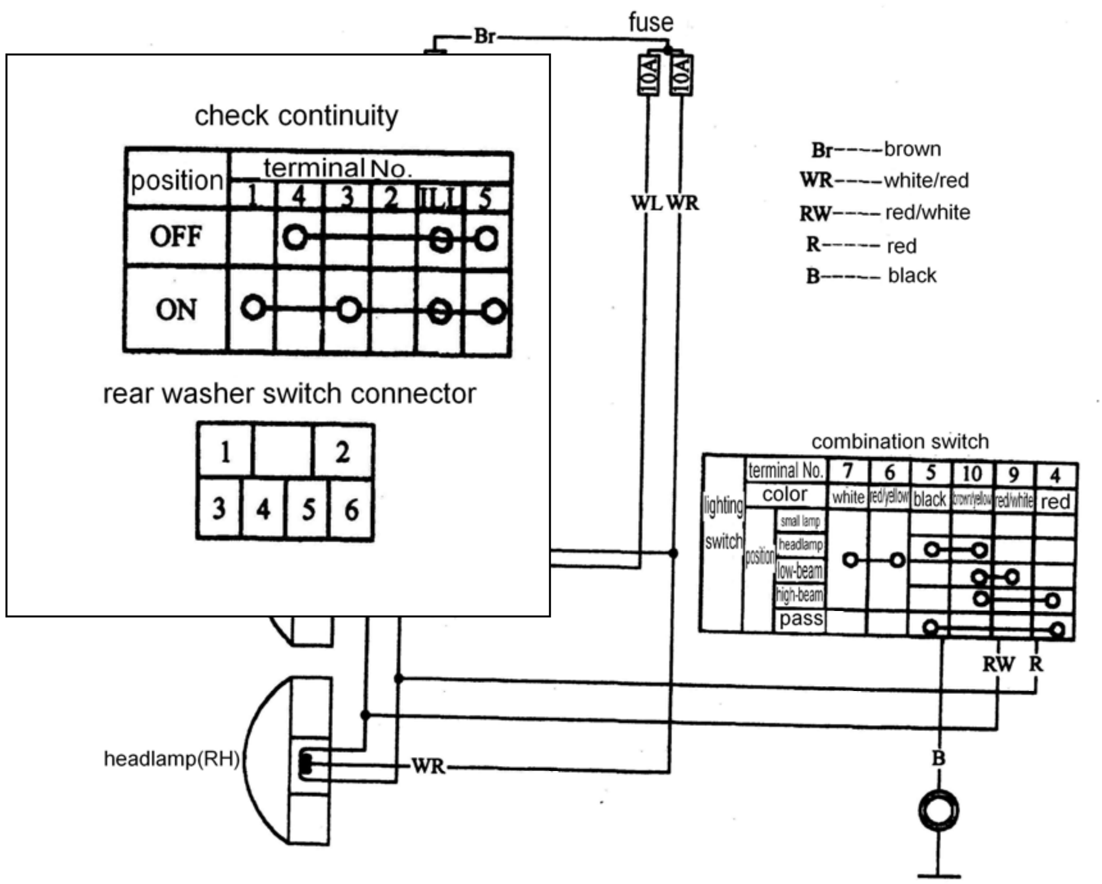
（2）Rear wiper

Connect the battery positive pole to terminal 1(shown in Fig. 17-11), the negative pole to the gear box and connect 2 to 3 using a jumping lead. Check the motor shaft for returning to the specified position..

4）Washer switch

Using a tester, check terminals for continuity.

The front wiper & washer switch (Fig. 17-8)



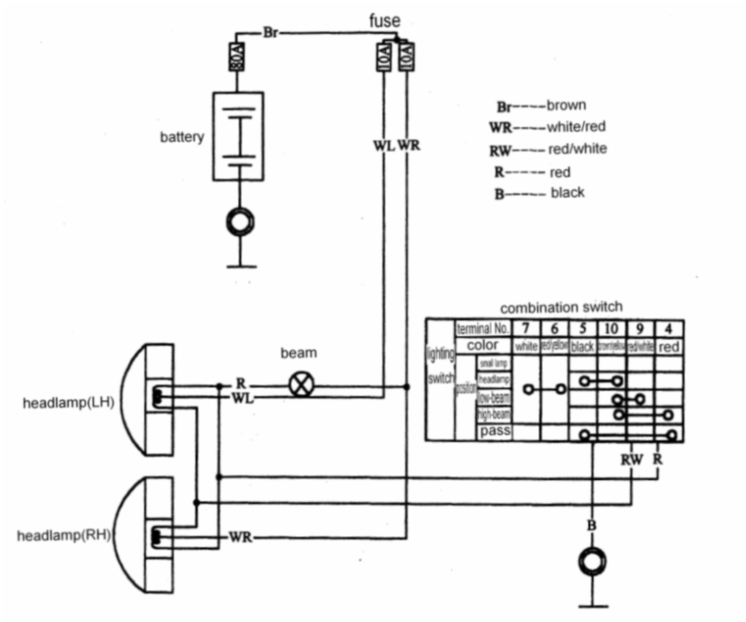


Fig. 17-13

2 Setting headlamp beams

There are several methods available for setting headlamp beams, such as screen method, focusing tester. Only screen method is included in the book.

Before setting the heading beams, adjust air pressure of four tires to a specified value respectively. A driver should be on the driver seat while setting headlamp beams. Move the vehicle over a flat surface. Place a blank wall 10m ahead of the headlamp. Check to see if the hot spot (high intensity zone) of each main (low) beam axils falls within a vertical range on the wall from 0.7H to 0.9H (H: the height from headlamp beam center to ground) (shown in Fig. 17-14) and a horizontal range on right to left (shown in Fig. 17-15)

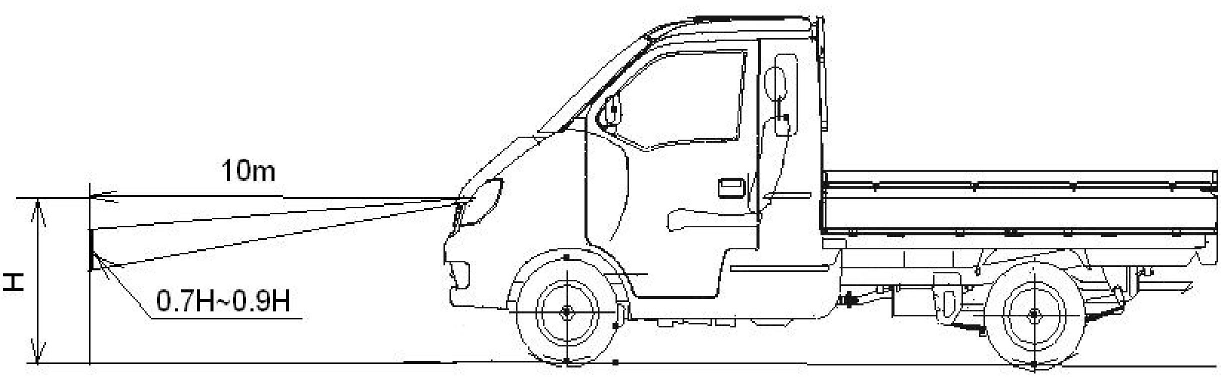


Fig. 17-14

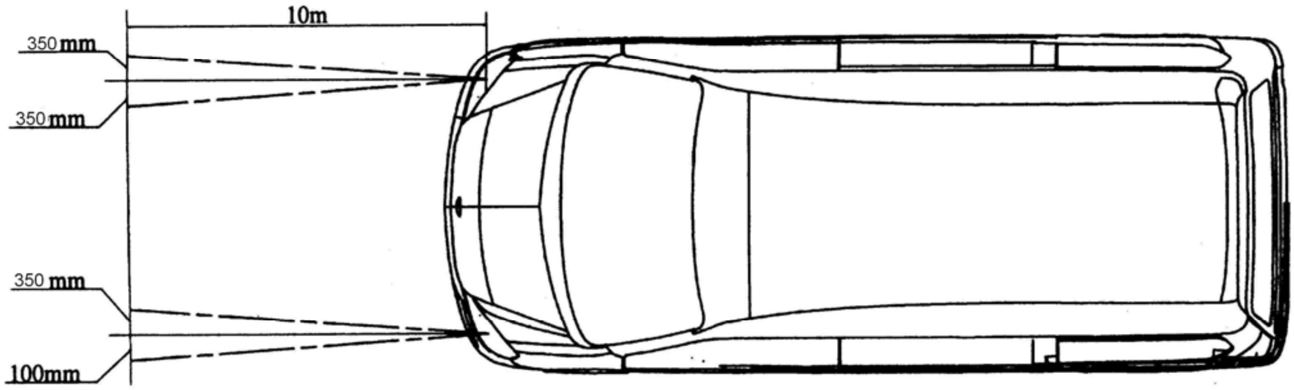


Fig. 17-15

3 Removal and Installation

Removal

The procedure that removes the headlamp is shown in Fig.17-16.

The procedure that installs the headlamp is reverse to the procedure of removal.

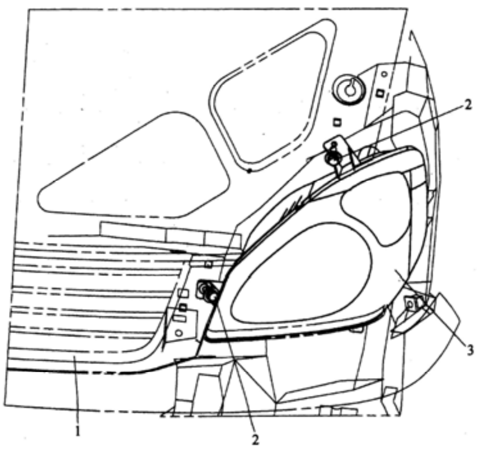


Fig. 17-16

Removal steps: 1- Front grill ; 2- Bolt; 3- Headlamp

4 SERVICE

1) Headlamp beam adjustment

There are tow hand-wheels on back of the headlamp for adjustment. Using these hand-wheels, adjust the beams as show in fig 17-17.

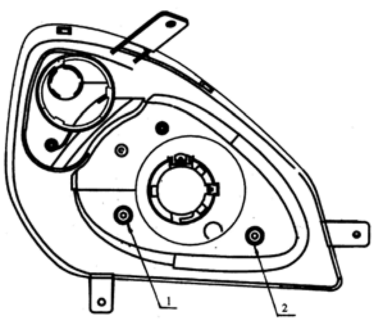


Fig 17-17

2）Combination switch

Shown in Fig.17-18, using a tester, check each circuit for continuity, as shown in Fig, 17-18. While turning the switch to ‘low beam’, lead RW (No.9) continues with lead B (No.5). While turning the switch to ‘high beam’, lead R (No.4) continues with lead B (No.5).

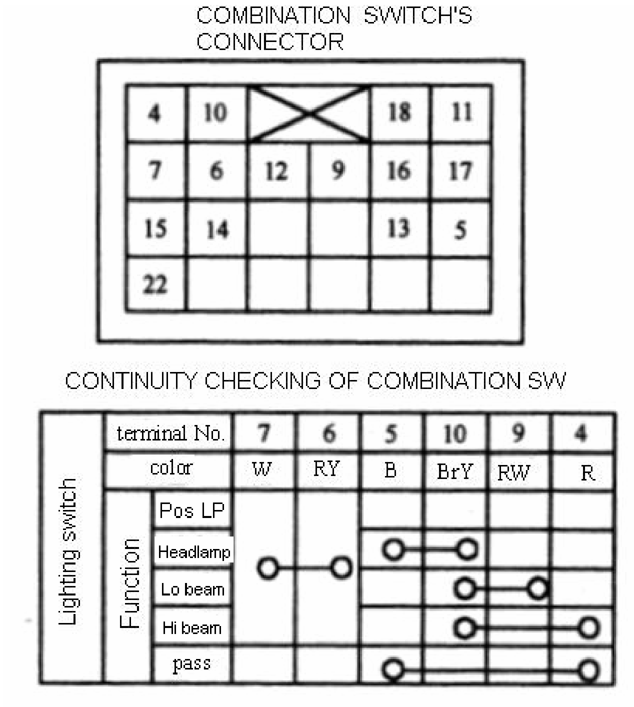


Fig.17-18

- **TAIL LAMP**

1 Circuit Diagram (see the Fig. 17-33 in 17.7 section)

2 Removal and Installation **(**Fig.17-19)

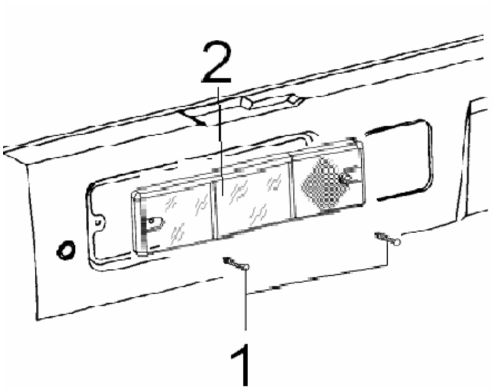


Fig.17-19 Tail lamp

Removal steps

1 Screw,tapping

2 Tail lamp

17.5 FOG LAMP

1 CIRCUIT DIAGRAM（Fig.17-20）

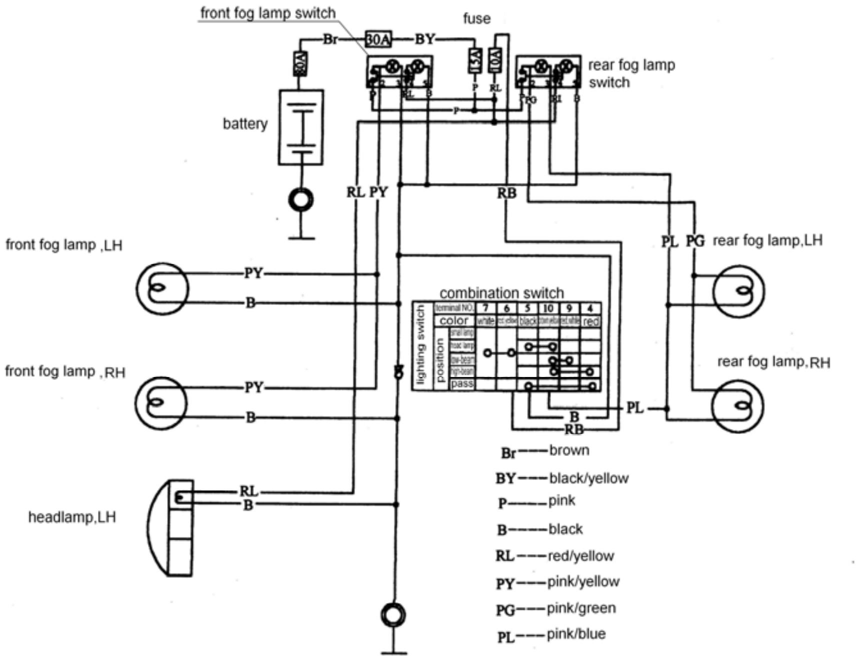


Fig 17-20

While position lamps ON, lead RY continues with lead B, and the illumination lights in front fog switch and rear fog switch light, with green color. While front fog light switch ON, lead PR continues with lead PR, the front fog lamps are lighted and operation indicator in the switch is lighted, with green color; illumination light goes out at same time.

Turn the combination switch to headlamp position, lead PL continues with lead B. Turn rear fog lamp on, which lead P continues with PG. The rear fog lamp is lighted, and the switch illumination light goes out, and operation indicator of the switch is lighted, with yellow color.

2 REMOVAL AND INSTALLATION

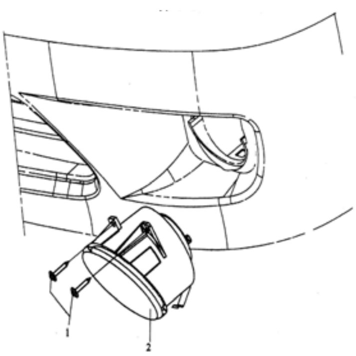
Removal steps

The procedure for removing the front fog lamp is shown in Fig. 17-21.

The procedure for removing the rear fog lamp is shown in Fig. 17-22.

The procedure for removing front fog lamp switch is shown in Fig. 17-23.

The procedure for removing rear fog light switch is shown in Fig. 17-24.



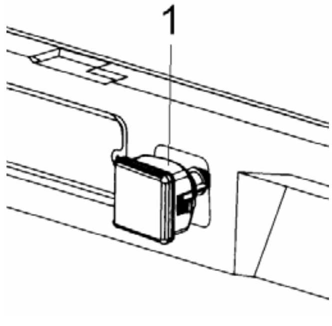


Fig 17-21 front fog lamp

Removal steps:

1-tapping screw ; 2-front fog lamp:

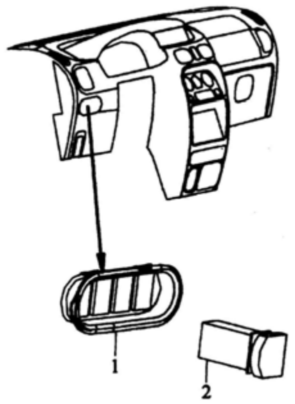


Fig 17-23

1-switch panel 2-front fog switch

Fig 17-22 rear fog lamp

Removal steps:

1- rear fog lamp

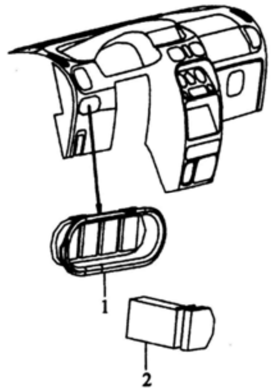


Fig 17-24

1-switch panel 2-rear fog switch

CAUTION

A piece of cloth should be used on end of the tool for removal (such as '- ' screwdriver) so as to protect rear bumper from scratch while removing rear fog lamp.

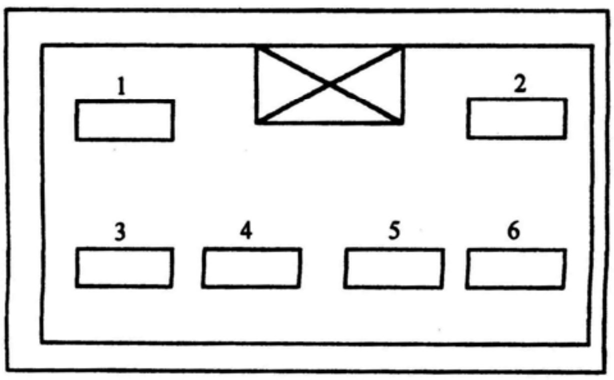
Installation

The procedure of installing fog lamps are in reverse to removing.

3 SERVICE

Using a tester, check the switches for continuity. When the front fog lamp switch is turned on, terminals 1, 2 and 3 continue. While turning the combination switch to position light, terminals 7 and 6 continues. When turning the combination switch to headlight, terminals 7 and 6 as well as terminals 5 and 10 continue. When the rear fog switch ON, terminals 1, 2 and 3 continue (as show in Fig. 17-27).

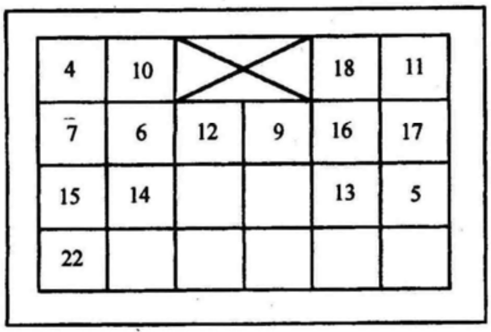
front fog lamp switch switch connector



front fog lamp switch check continuity

position	terminal No.					
	1	4	ILL	3	2	5
OFF		○	⊗			○
ON	○		⊗	○	○	

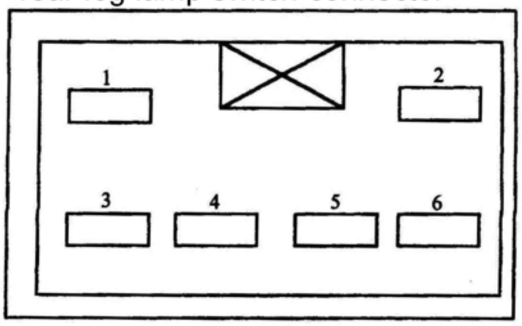
Fig 17-25



combination switch check continuity

<table>
<tr><td rowspan="7">lighting switch</td><td colspan="2">terminal NO.</td><td>7</td><td>6</td><td>5</td><td>10</td><td>9</td><td>4</td></tr>
<tr><td colspan="2">color</td><td>white</td><td>red,yellow</td><td>black</td><td>blown,yellow</td><td>red,white</td><td>red</td></tr>
<tr><td rowspan="5">position</td><td>small lamp</td><td rowspan="4">○</td><td rowspan="4">○</td><td></td><td></td><td></td><td></td></tr>
<tr><td>head lamp</td><td>○</td><td>○</td><td></td><td></td></tr>
<tr><td>low-beam</td><td></td><td>○</td><td>○</td><td></td></tr>
<tr><td>high-beam</td><td></td><td>○</td><td></td><td>○</td></tr>
<tr><td>pass</td><td></td><td></td><td>○</td><td></td><td></td><td>○</td></tr>
</table>

Fig 17-26



rear fog lamp switch check continuity

switch position	terminal No.					
	1	4	ILL	3	2	5
OFF		○	⊗			○
ON	○		⊗	○	○	

Fig 17-27

17.6 COMBINATION SWITCH

1 REMOVAL AND INSTALLATION

REMOVAL

The procedure for removing is shown in Fig. 17-28.

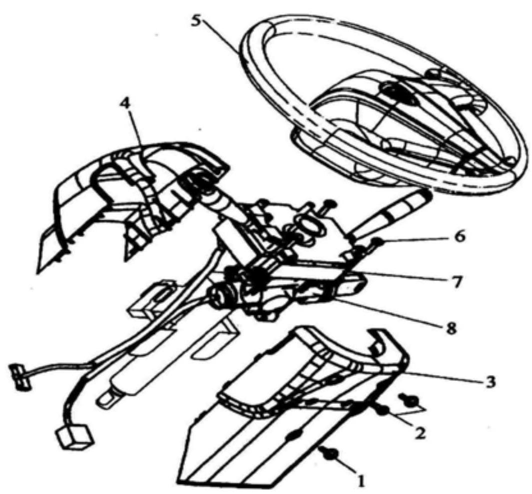


Fig 17-28 COMBINATION SWITCH ignition switch

INSTALLATION

Reverse to removing.

2 SERVICE

What check combination switch for continuity and service sees the circuit for turning & hazard, illuminating circuit.

> CAUTION
>
> The bolts fitted ignition switch with have been broken while installing, because of thief-proof, so that a bolt should be welded to which the bolts broken place is. Rotate in reverse direction to remove ignition switch.

17.7 TURNING AND ILLUMINATION CIRCUIT

1 CIRCUIT DIAGRAM FOR TURNING AND HAZARD (Fig. 17－29)

1) Turning signal

While the hazard switch OFF, which terminals 4 and 6(lead Y and lead OB) of hazard switch continues, lead G and lead GR continues with turning to ‘ left’, and lead G and lead GY continues with turning to ‘right’.

2) Hazard signal

When the hazard switch is turned ON, terminals 4, 6 is broken, terminals 2 , 4 continues; and terminals 3,5,1 continue. Left and right turning signal lights flash, so does hazard indicator in combination meter.

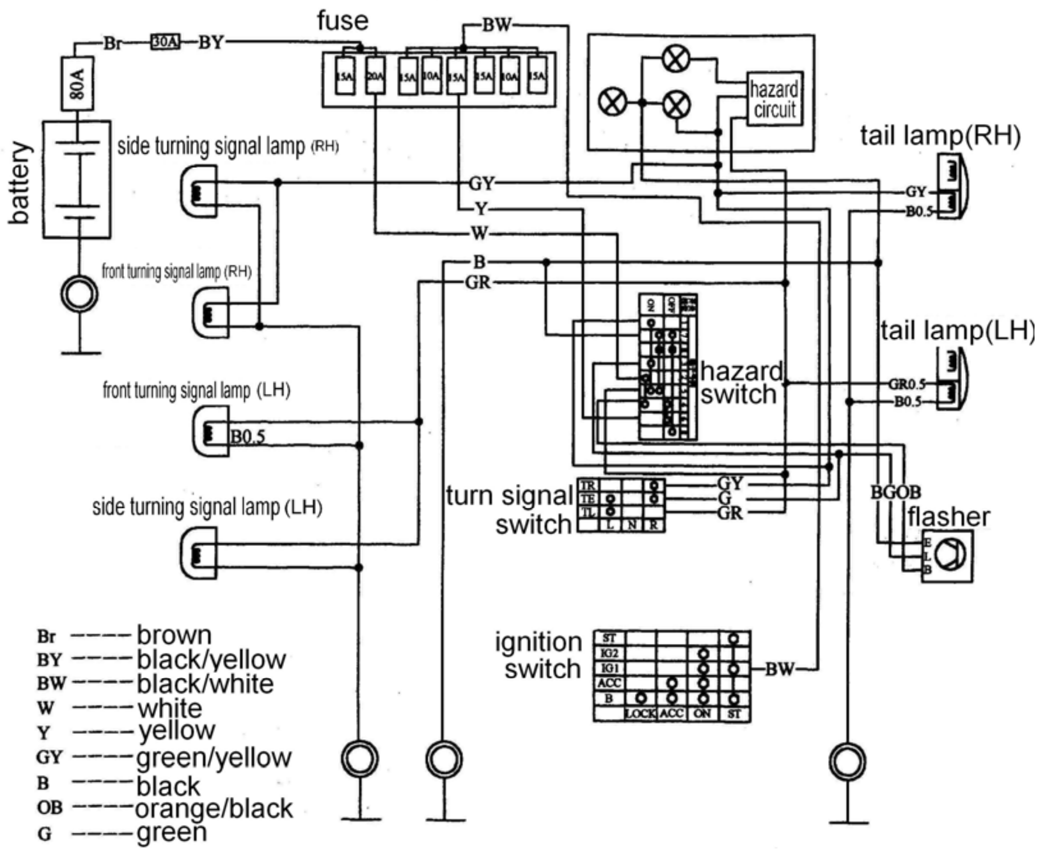


Fig 17-29

3) Service

(1)Trouble diagnosis

Trouble	Possible cause	Correction
No flashing continues on either side, right or left.	Fuse blown	Replace
Flashing continues when hazard switch ON; no flashing continues when turning signal switch is turned to ‘left’ or ‘right’	20A-fuse blown or turning signal contacts in combination switch contact poor.	Replace or repair
No flashing continues when turning. So does hazard.	10A-fuse blown, or the contacts in hazard switch poor	Replace or repair
Flashing frequency is unsteady, or lights continue to light	Flasher faulty	Replace
Only one side of lights flash when hazard switch ON.	Contacts in hazard switch faulty	Replace

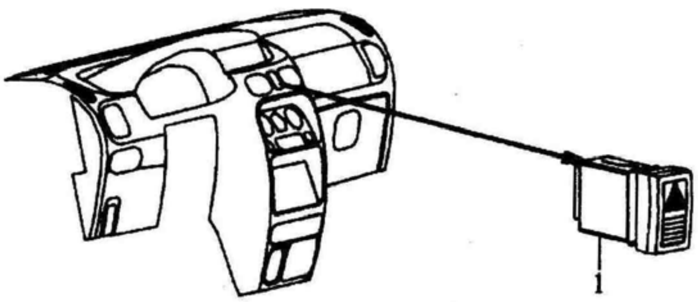


Fig 17-30

(2) Hazard switch

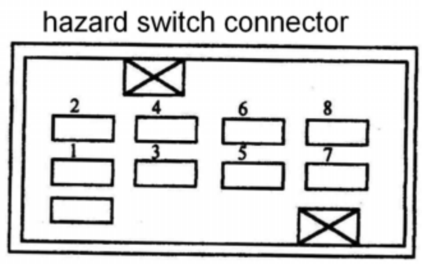
Removal and Installation see Fig.17-30

Using a tester, check each pair of terminals for continuity (Fig. 17-31)

Press knob of the hazard switch, terminals 4, 6 breaks , terminals 2, 4 continues and terminals 3,5,1 continue.

(3) Turning signal switch

Turn off hazard switch, terminals 2, 4 of the switch should continues (Fig 17-32); turn shaft of the combination switch to ‘left’, terminals 16,17 of the switch should continue; turn to ‘right’, terminals 17,18 of it should continue.



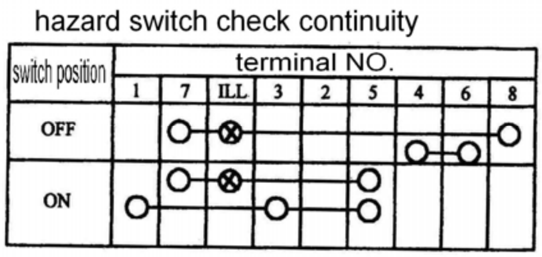


Fig 17-31

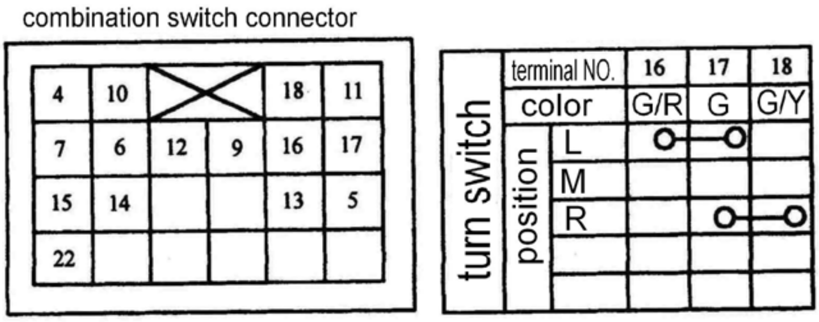


Fig 17-32

Trouble	Possible cause	Correction
All lights isn’t lighted	Fuse link blown, or contacts of the combination switch faulty	Replace or repair
Only lights on left side isn’t lighted	10A-fuse for lights on this side blown	Replace
Only lights on right side isn’t lighted	5A-fuse for lights on this side blown	Replace

2 ILLUMINATION CIRCUIT

1) Circuit diagram sees fig.17-33

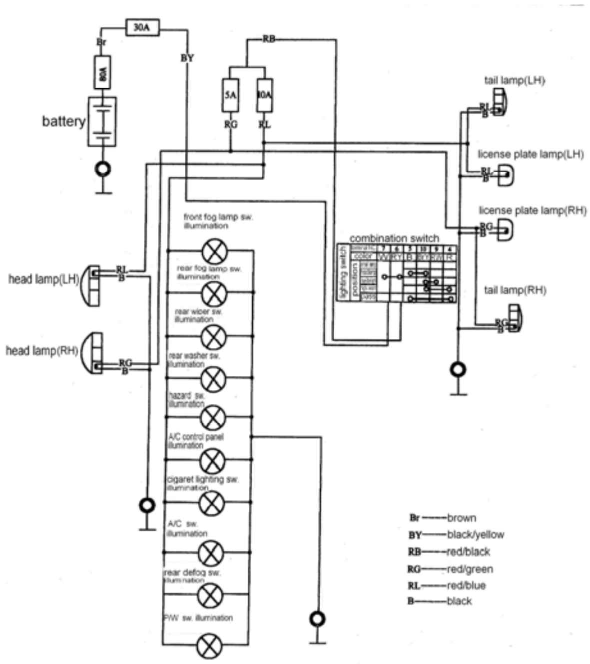


Fig 17-33

When light switch in the combination switch is turned to I or II position, lead RB and lead BY continues, and position lamps are lighted.

2) Service

(1)Trouble diagnosis

(2) illumination switch

Using a tester, check illumination switch for continuity. When turning the switch to position of small light, terminals 6, 7 continues

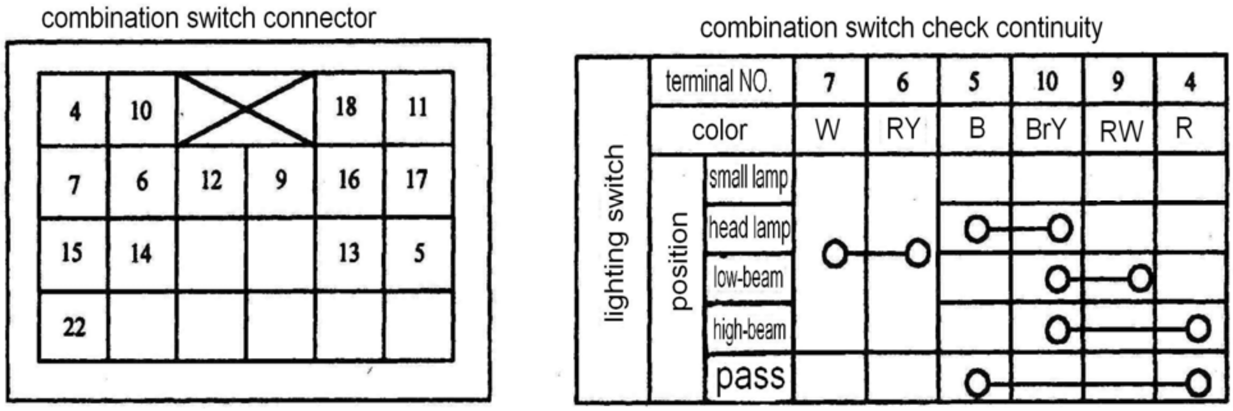


Fig 17-34

17.8 POWER WINDOW

1 **CIRCUIT DIAGRAM**

See Fig. 17-35

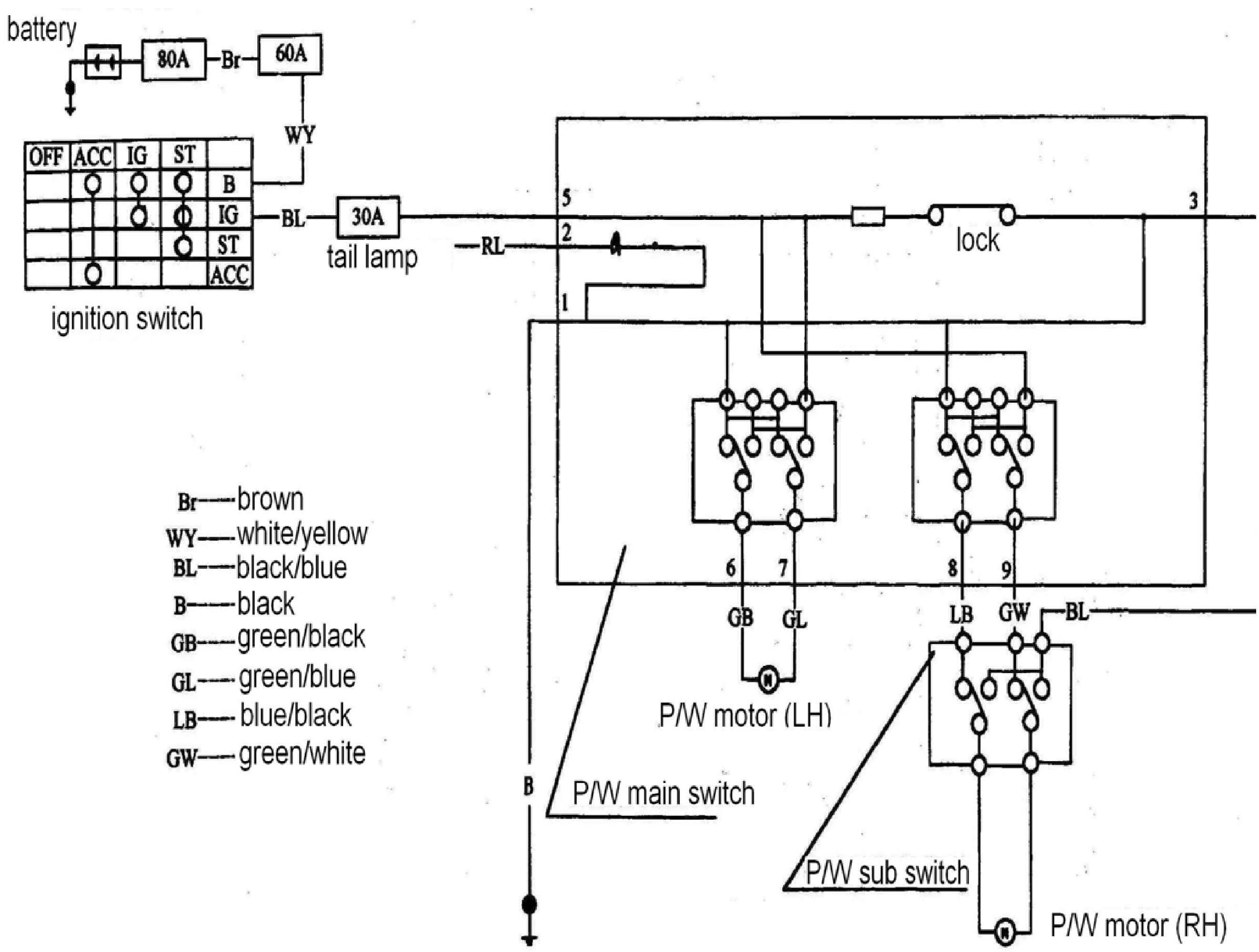


Fig. 17-35

2 REMOVAL AND INSTALLATION

Removal and installation for P/W main switch sees Fig. 17-36; for sub switch sees Fig. 17-37.

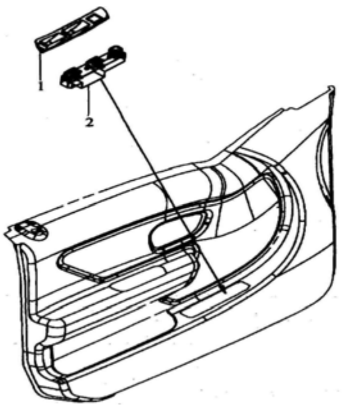


Fig. 17-36

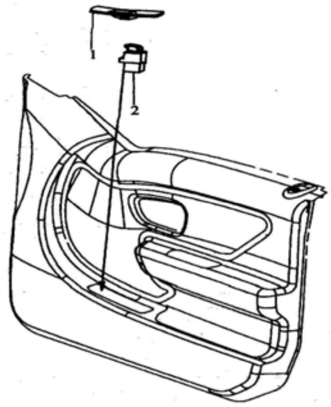


Fig. 17-37

Removal steps:

Removal steps:

1-P/W main switch 2- P/W sub switch

3 SERVICE

Using a tester, check P/W main switch and sub switch for continuity, as shown in Fig. 17-38.

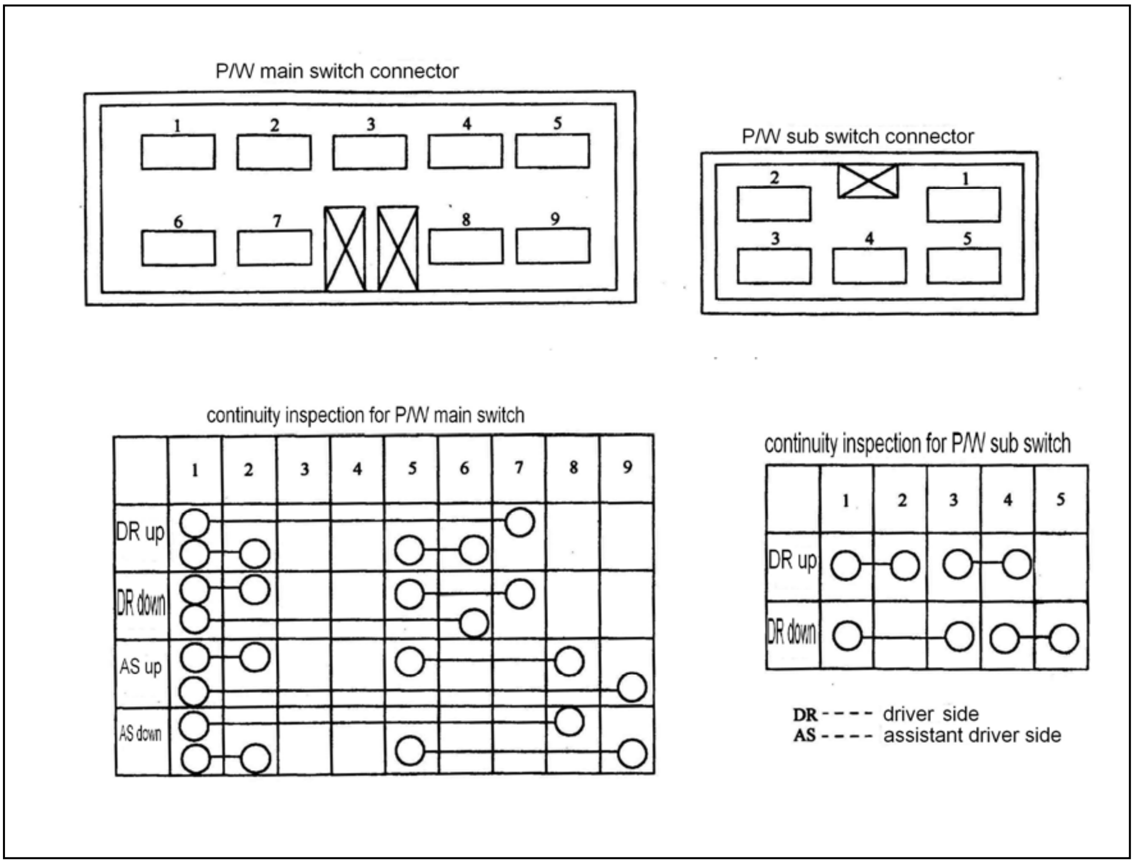


Fig　17-38

17.9 BATTERY

1、BATTERY

1）ON-VEHICLE INSPECTION

Battery used in this vehicle is the type of maintain – free, as shown in Fig17-39. Using a located in battery to show, Inspect battery for charging condition with densimeter located in battery (Fig.17-40).

(1) Color seen from observe-hole of densimeter is green when electrical quantity is over 65 percent of the capacity.
(2) Color seen from observe-hole of densimeter is black when electrical quantity is below 65 percent of the capacity.
(3) What is seen from observe-hole of densimeter is transparent , that is shown that the battery is useless.　Replace it.

2）CHARGING

(1) With charging battery on vehicle, it is necessary to disconnect the wire from battery negative pole o protect electric parts from damage.
(2) Charging current is one tenth of battery capacity in normal condition. With quick charging because of time, charging current should be no more than the value of battery capacity in ampere absolutely.

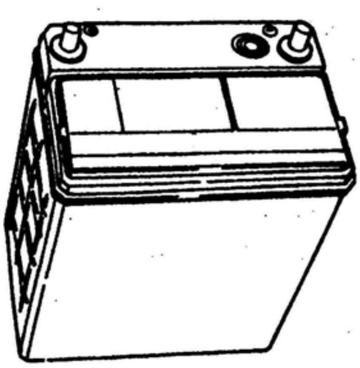


Fig.17-39

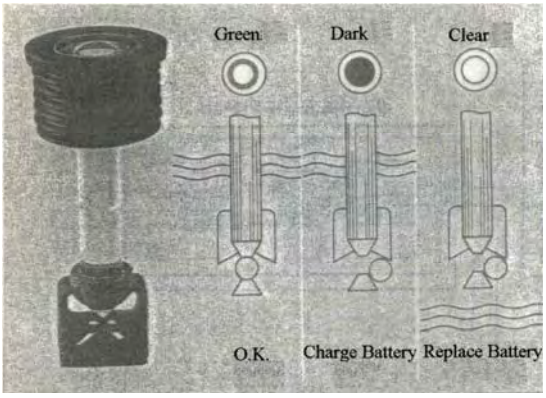


Fig.17-40

CAUTION
1. Not charge near fire, otherwise, explosion may generate.
2. No operation that may generate spark is available while charging.

3、SPECIFICATION AND DATA

Type	Capacity	Starting current	Remark
MX100－S6LMF	45AH	430	MT

17.10 INSTRUMENT PANEL

1 REMOVAL AND INSTALLATION

The procedure for removing sees Fig. 17-42

The procedure for installing is in reverse to removing.

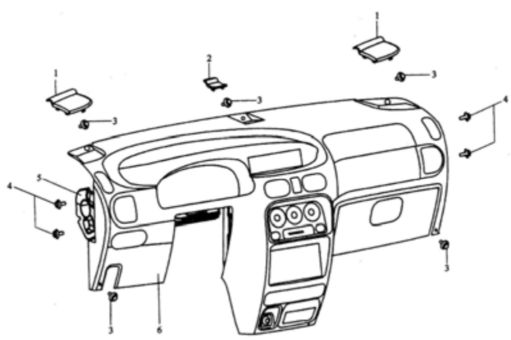


Fig. 17-42

Removal steps:

1. speaker cover 2. screw lid 3 . bolt 4. combination bolt 5. member Steering Support 6. instrument panel

17.11 ELECTRIC CONTROLLING

1 FUSE

1) The vehicle uses three fuse boxes, which are class I, class II and class III. Fuses position in the fuse boxes are shown on the box lids., as shown in Fig 17-43, Fig. 17-44 and Fig. 17-45

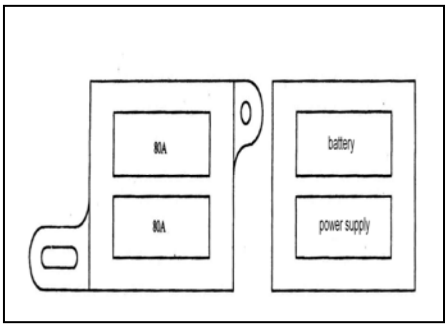


Fig17-43

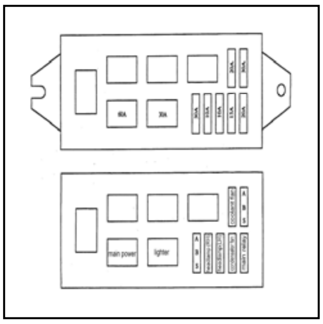


Fig 17-44

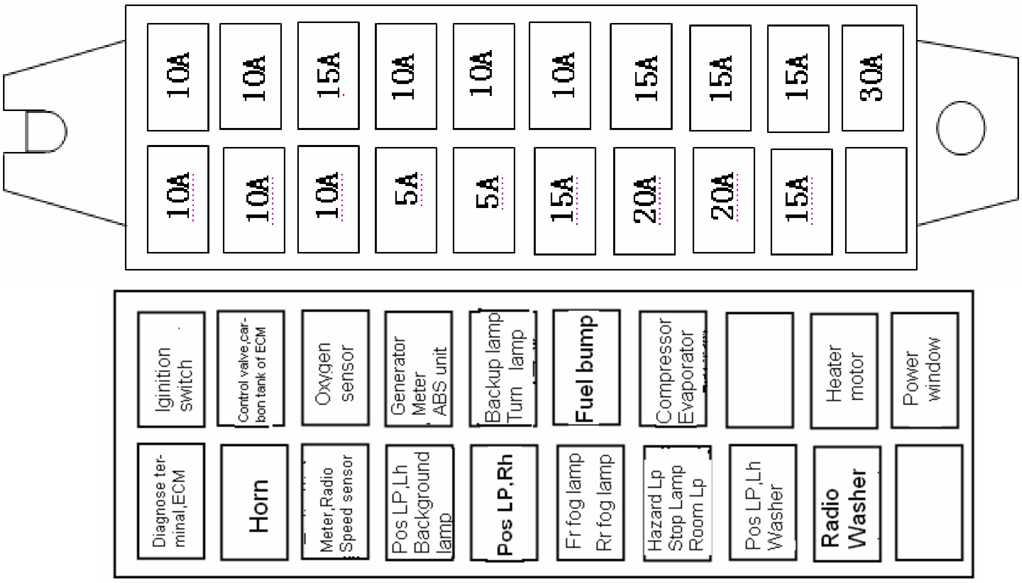


Fig 17-45

2) Fuses distribution (see Fig. 17-46)

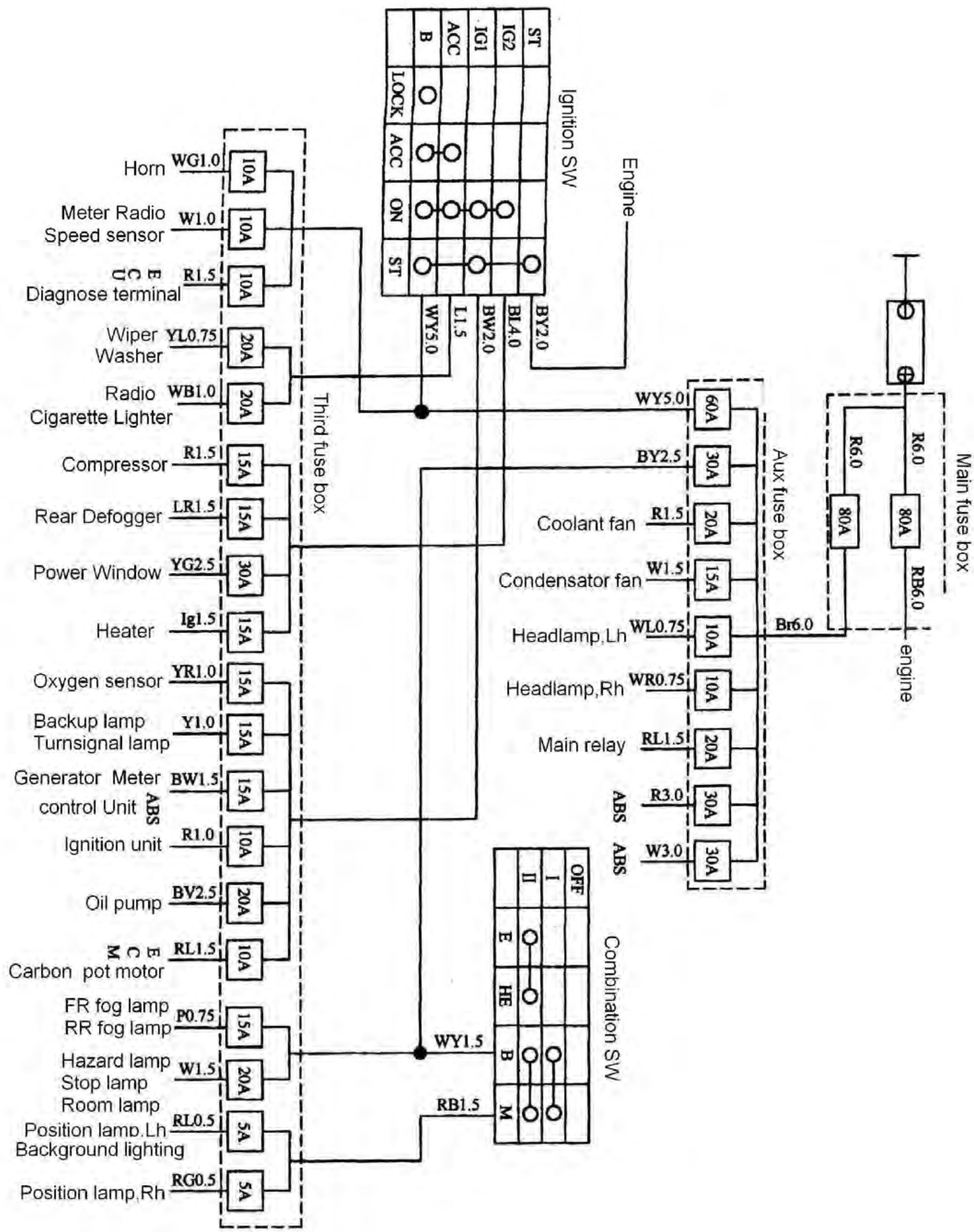


Fig. 17-46

2 VEHICLE CIRCUIT DIAGRAM

The circuit diagram of the vehicle with MT20 EMS of Delphi sees Fig. 17-47a. That with MT20U EMS of Delphi sees Fig. 17-47b.

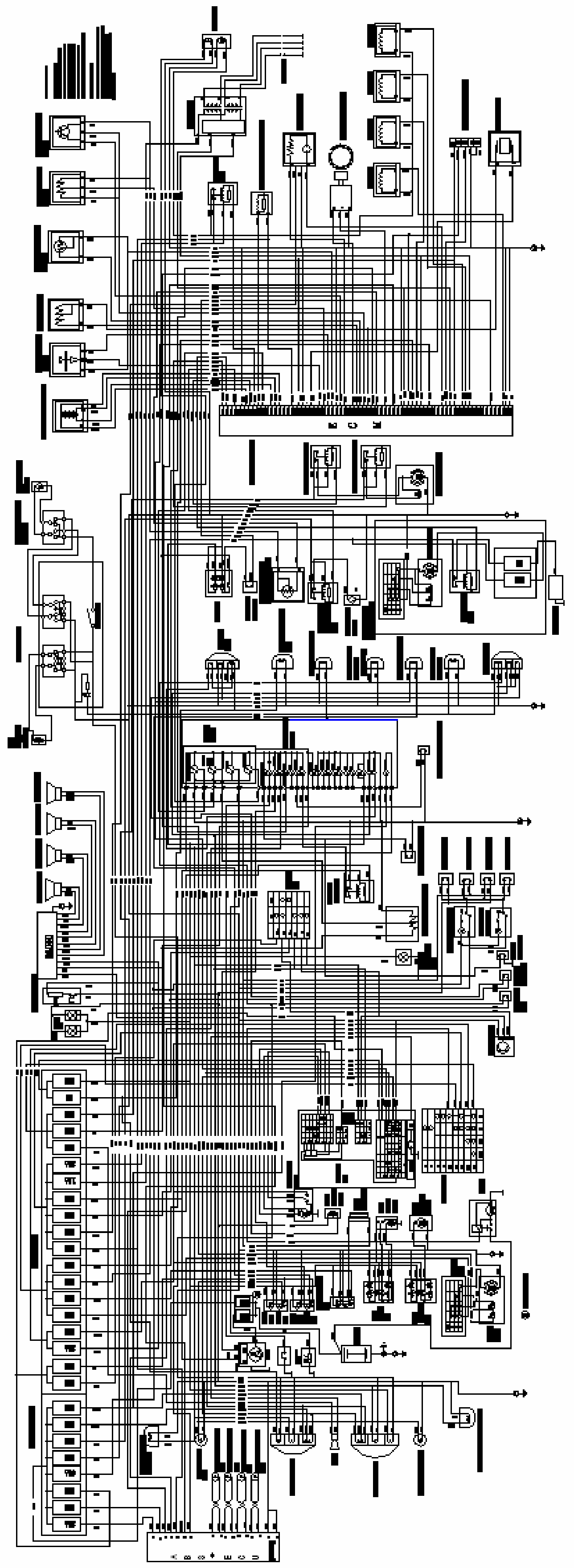


Fig. 17-47a

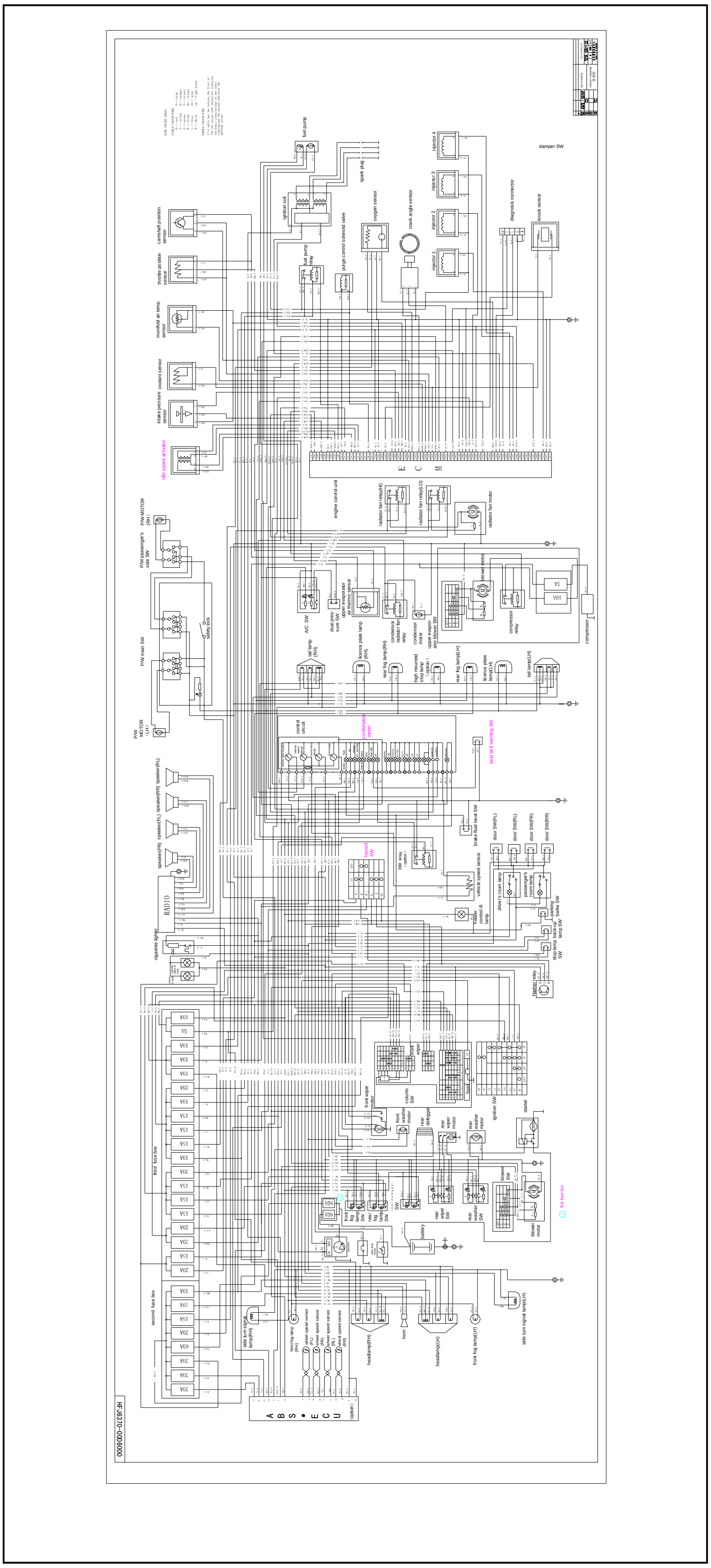


Fig. 17-47b

18 AIR CONDITIONING SYSTEM

18.1 GENERAL DESCRIPTION

Air condition system in the vehicle consists of independent parts, and is applied to defrost, heat, cooling and ventilate. The system uses a method that compresses gas to cool, as other model basically. Specifications see Table 18-1.

Table 18-1

Item	Model
Heater	Hot water
Front evaporator	Laminated
Roof evaporator	tube-fin
Condenser assembly	Parllel—flow
Compressor	Rotary vane <JIANSHE> Scroll <AOTECAR>
Refrigerant (g)	R-134a, 650±20<Single-front evaporator A/C > 950±20<Dual evaporator A/C>

- **NOTICE FOR SAFTY**

The refrigerant of R-134a is a kind of compound, which is made from hydrogen, carbon and fluorine (HFC), and apply hydrogen instead of chlorine, to protect environment

Refrigerant of R-134a is transparent in state of liquid or gaseity. It is gaseous in normal temperature and pressure because it vapors at -29.8℃ at atmospheric pressure. The gas is more weight than air. It is impossible for the gas to fire or explosion.

When handling the refrigerant of R-134a, pay attentions as follows:

Caution

• It always necessary to wear goggles to protect your eyes when handling refrigerant.
In normal temperature and pressure, R-134a evaporates rapidly, and R-134a can make anything touching it frozen. So be careful to operate it. Do not make liquid refrigerant touch your skin, especial your eyes. When handling refrigerant, always wear goggles to protect your eyes. Operating to A/C system, prepare a bottle of asepsis mineral oil for use. In case that liquid refrigerant enters your eyes, drop a few drops of oil on eyes for cleaning up the refrigerant because of R-134a being absorbed rapidly by oil. Moreover use quantities of cool water to wash your eyes. After handling by yourself, call a doctor immediately for help to prevent them from inflammation.

• Don’t heat R-134a refrigerant higher than 40℃
In general case, when charging or refilling refrigerant, the proper temperature is necessary so that the pressure of refrigerant in container is higher than the pressure of refrigerant in A/C system.
So use hot water below 40℃ in barrel or large pan to heat the container fully. Don’t heat the container by jet-lamp or other ways to lift temperature and pressure of the container so that don’t exceed the temperature prescribed. Don’t weld or wash by steam near parts or pipes of A/C system.

• Keep the service can upright when charge A/C system.
Keep the service can upright when charge A/C system. If the service can is lying or inverted, liquid refrigerant may be drawn into the compressor damaging it by liquid compression.

• Use special leakage inspection meter for R-134a to inspect leakage of refrigerant.

• Do not allow liquid refrigerant to touch bright metals.
rigerant can tarnish the surfaces of bright metals including chrome steel, and refrigerant combined with moisture is corrosive heavily to surfaces of all metals.

18.2 SERVICE SPECIFICATIONS

1 STANDARD VALUE (see Table 18-2)

Table18-2

Item		Standard
Idle speed (A/C OFF)		850±50 rpm
Idle speed (A/C ON)		1000±50 rpm
Resistor resistance for blower motor(Ω)	H-M	0.8
	H-L	2.5
	L-M	1.7
Compressor magnetic clutch clearance (mm)		0.3~0.6<JIANSHE>
Refrigerant temperature switch operating temperature (℃)	ON	150±5<JIANSHE> 130±5<AOTECAR>
	OFF	130±5<JIANSHE> 105±5<AOTECAR>

2 LUBRICANTS (see table 18-3)

Table 18-3

Item		Specified lubricants	Quantity
Compressor oil	JSS-96HZ1a	RS20	220 ml
	JSS-96ZV4	RS20	220 ml
	WXH13-066	PAG56	110 ml
	WXH-066-P4	PAG56	110 ml
	WXH-066-A32	PAG56	130 ml
	WXH-066-N	PAG56	110ml
	SP-10	PAG105	150ml
Pipe coupling (ml)		PAG56	As required

3 TROUBLE DIAGNOSIS

(1) **Procedure for** trouble inspection (see Table 18-4)

Table 18-4

Item	Trouble			
	1. Fail to work at all.	2. Tempreture inside is not drop when A/C is working	3. Blower fails to work	4. Blower fails to stop
Fuses	1	—	1	1
Connectors	2	—	2	2
Refrigerant	3	1	—	—
Compressor relay	4	4	—	—
Magnetic clutch	5	5	—	—
Refrigerant temperature switch	6	2	—	—
A/C switch	7	—	—	—
Blower	—	—	3	—
Blower switch	8	—	4	3
Resistor	—	—	5	4
Pressure switch	9	3	—	—
Engine-ECU	10	—	—	—

Note : The number shows check procedure number.

(2) **Trouble diagnosis (see table18-5)**

Table 18-5

Trouble	Possible cause	Correction
Insufficient warming air	Control mechanism is damaged or operated incorrectly.	Repair
	Valve faulty	Replace
	Ducts clogged	Inspect and repair
	Heating core leakage or clogged	Replace

	Hot water pipes leakage or clogged		Replace
Insufficient cooling air	Blower motor operates well	Ventilation housing clogged	Repair
		Evaporator frosts	Repair
		Filter in receiver clogged	Replace receiver
		Ducts clogged	Repair
	Blower motor inoperative	Switch fault y	Repair or Replace
		Resistance incorrect	Replace
		Fuse blown	Check and remedy
		Connectors poor	Check and remedy
		Blower motor faulty	Replace
		Fan damaged	Replace
Cooling system inoperative	Fuse blown		Replace
	Connectors poor		Repair
	Insufficient or excessive refrigerant		Charge refrigerant Repair leakage place Discharge refrigerant
	A/C compressor replay faulty		Replace
	A/C pressure switch faulty		Replace
	Magnetic clutch faulty		Replace
	Overheat-proof switch inside compressor faulty		Replace
	A/C switch faulty		Replace
	Blower switch faulty		Replace
	Engine-ECU faulty		Replace
Inside temperature fails to decrease while cooling system working(No cooling air)	Leak in the system.		Charge refrigerant Repair leakage place
	Overheat-proof switch in compressor faulty		Replace
	Condenser fan controller faulty		Replace
	A/C compressor switch faulty		Replace
	Magnetic clutch faulty		Replace compressor
Blower motor inoperative	Fuse blown		Replace
	Connectors poor		Repair
	Blower motor faulty		Replace
	Blower switch faulty		Replace A/C control panel
	Resistance faulty		Replace
	Fan faulty		Replace
Blower motor fails to stop	Fuse blown		Replace
	Connectors poor		Repair
	Blower switch faulty		Replace
	Resistance faulty		Replace

18.3 ON-VEHICLE SERVICE

1. DAILY MAINTENANCE

Daily maintenance is regular inspection for appearance by eyes. Problems which are found must be eliminated in time. Daily maintenance items are as follows:

① Inspect fins of condenser for dirt and others. Clean and repair it if necessary.

② Inspect cooling pipes for interfere with other parts. Inspect couplings for oil trace of refrigerant leakage. Repair them if necessary.
③ Inspect couplings of cooling pipes and connectors of harness for reliability.
④ Inspect compressor drive belt for proper tension state. Adjust it if necessary.
⑤ Inspect whether the temperatures of suction hose and discharge hose are normal or not. Judge whether refrigerating capability is normal by cool airflow that A/C system blows or not.
⑥ Observe whether refrigerant is enough by sight glass of receiver or not.

2. REGULAR MAINTENANCE

Items and contents of regular maintenance of A/C system are shown in Table 18-6.

Table 18-6

Items	Inspection content	Maintenance schedule				
		Week	Month	Season	Year	Replacing schedule
Whether refrigerant is sufficient or not	Observe by sight glass of receiver		●			
Cooling pipes	Inspect couplings for oil trace and refrigerant leakage.		●			
	Inspect whether clamps for fixing pipes are loose or not.			●		
	Inspect whether flexible hoses are injured or aging or interfere with other parts or not.		●			
Surface of condenser	Inspect whether there are dirt or others or not. Clean its surface and repair distorted fins.	●				
Heater motor	Measure whether current and voltage are normal or not.				●	
Surface of evaporator	Clean dirt.				●	
Expansion valve	Pressing state of feeling temperature element.				●	
Receiver	Inspect whether receiver is clogged by dirt or not. Receiver must be replaced if desiccant is saturated or if there is dirt in receiver.				●	Had better replace in maintenance.
Thermal resistor	Inspect thermal resistor in cool water of -1～5℃. Measure resistance of thermal resistor when temperature of water is various. Replace thermal resistor if the resistance is not correct.					Inspect when replace it.

Compressor	Inspect whether shaft seal is leakage or not.		●			
Compressor mounting bracket and adjusting bracket	Inspect whether they are loose or not.		●			
Magnetic clutch	Inspect whether operation of magnetic clutch is normal or not and whether the clearance between the pressure plate and drive clutch is normal or not.		●			
Drive belt	Inspect whether the belt tension is correct or not.		●			
A/C control components	Inspect whether the functions of A/C switch, relay, pressure switch, fan switch and fan resistor are normal or not.				●	
Heater control unit	Inspect whether the functions of mode control knob and temperature control knob are normal or not.				●	
Wiring harness	Inspect whether connectors are reliable or not.		●			
Cases of A/C components	Inspect whether mating parts are air leakage or not, and whether damping cushions are breaking off or not, and whether there are crack and damage on cases or not.				●	
Heater ducts	Inspect whether heater ducts are deformed or not, and whether there are crack and damage on heater ducts or not.				●	

3. INSPECT CHARGE OF REFRIGERANT BY LOOKING AT THE SIGHT GLASS

The sight glass is the indicator of refrigerant charging amount. Clean the sight glass to see clearly the condition. Inspect and repair as shown below:

①Start the engine.

②Turn the blower switch to ‘HI’. Turn on the A/C switch, and set the temperature control to MAX COOL.

③Keep the engine speed of 1800r/min.

④ Check the refrigerant condition (bubble state) through the sight glass. Refer to Fig. 18-1 and Table 18-7.

⑤ Charge refrigerant as insufficient , and take back refrigerant as excessive.

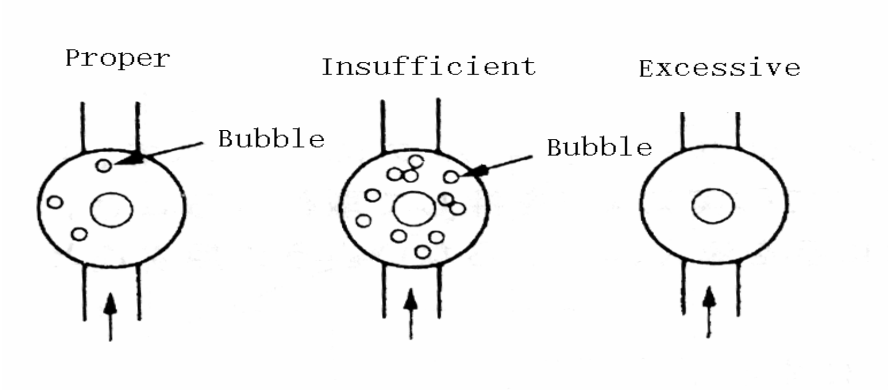


Fig. 18-1

Table 18-7

Items	Symptom
Proper	Bubbles are seen by accident. Bubbles disappear when speed of engine rises slightly.
Insufficient	A lot of bubbles are seen. If refrigerant is insufficient badly, white bubbles appear.
Excessive	No bubbles are seen.

NOTE

Always charge through the valve in low side of A/C system.

4. INSPECTION AND REPAIR OF RECEIVER

When air conditioner is turn ON, check temperature difference between receiver inlet and outlet with hand. Noticeable difference means that the receiver is clogged. Replace the receiver.

5. INSPECTION AND ADJUSTMENT FOR DRIVE BELT

When the belt is loaded with 98N on the middle, the offset in the middle should be in the range of 7～10mm.

6．CHARGE OF REFRIGERANT **(Fig.18-2、18-3、18-4、18-5)**

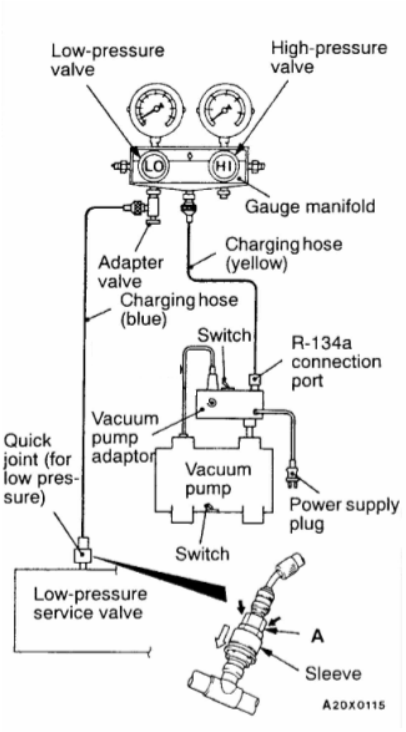


Fig. 18-2

(1). With the handles turned back all the way (valve closed), install the adaptor valve to the low-pressure side of the gauge manifold.

(2). Connect the charging hose (blue) to the adaptor valve

(3)Connect the quick joint (for low-pressure) to the charging hose (blue).

(4). Connect the other end of the quick joint (for low-pressure) to the low-pressure service valve.

Remark
The low-pressure service valve should be connected to the suction hose

Caution
1. Use tools that are suited to R-134a.
2. Installing the quick joint, press section “A” firmly against the service valve until a clatter is heard. When connecting, run your hand along the hose while pressing to ensure that there are no bends in the hose.

(5) Close high and low-pressure valves of the gauge manifold.

(6) Attach the vacuum pump adaptor to the vacuum pump.

(7) insert the vacuum pump plug to the vacuum pump adaptor.

(8) Connect the charging hose (yellow) to R-134a port of the vacuum pump adaptor.

(9)Turn in the handles of adaptor (valve open).

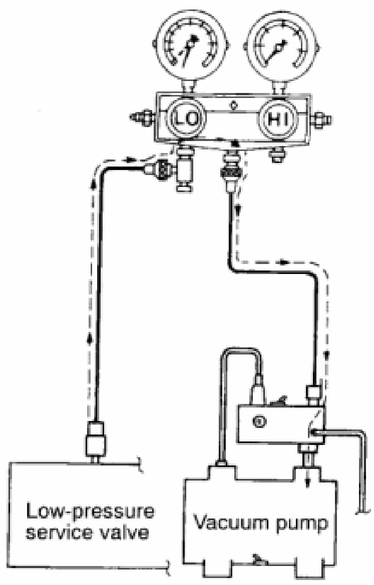


Fig.18-3

(10) Open the low-pressure valve of the gauge manifold.

(11)Turn the power switch of the vacuum pump to the “ON” position.

Remark
Even if the vacuum pump power switch is turned to “ON” position, the vacuum pump would not operate.

(12)Turn the switch of vacuum pump adaptor to the R134a side to start the vacuum pump

CAUTION
Do not run the compressor for evacuation。

(13)It takes about 10 minutes to evacuate to vacuum 100 kPa (1.0kgf/cm^2) or higher.

(14). Turn the switch of vacuum pump adaptor to “OFF” position and remain it for 5 minutes

CAUTION
Do not operate the compressor in the vacuum condition; otherwise damage may occur.

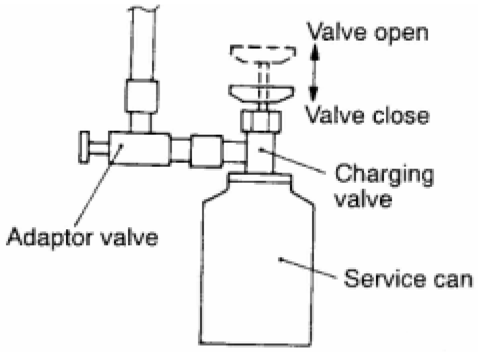


Fig.18-4

(15) Carry out a leakage test. It is normal if the negative pressure does not drop

⒃ With the handle turned back all the way (valve open), install the charging valve to the service can。

⒄urn the handle of the adaptor valve back all the way(valve closed), remove it from the gauge manifold and install the service can。。

⒅Tighten the handle of the charging valve (valve closed) to puncture the service can.

⒆. Turn the handle of the charging valve back (valve open) and tighten the handle of the adaptor valve (valve open) to charge the system with refrigerant.

CAUTION

If the service can is placed upside down, liquid refrigerant may be drawn into the compressor , which damage for liquid compression.

Keep the service can upright to ensure that refrigerant is charged in gas state.

⒇If the refrigerant is not drawn in, turn the handle of the adaptor valve back all the way (valve closed) .

(21) Check for gas leaks using a leak detector.。

If a gas leak is detected, re-tighten the connections, and then repeat the charging steps from (12).

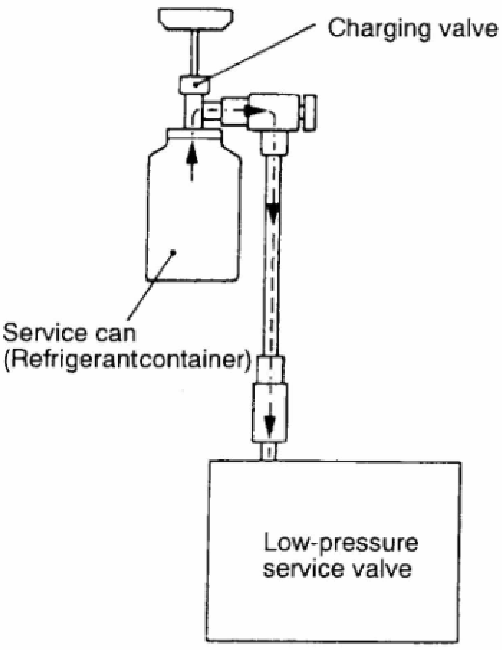


Fig. 18-5

Caution

Only t he leak detector for R-134a is available.

(22) Start the engine,

(23). Operate the A/C and set the temperature knob at 'COOL'.

(24) Keep the engine speed at 1,800r/min.

(25) Tighten the handle of the adaptor valve (valve open) to charge the required volume of refrigerant.

Caution

If the service can is placed upside down, liquid refrigerant may be drawn into the compressor, which is damaged by liquid compression. Keep the service can upright to ensure that refrigerant is charged in gas state.

(26) .After charging with refrigerant, turn the handle of the adaptor valve back all the way (valve closed).

(27) .Tighten the charging valve handle (valve closed).

Remove the quick joint from low-pressure charging valve (for low pressure side).

7. Refill refrigerant by the service can when refrigerant is insufficient **(Fig. 18-6、18-7、18-8)**

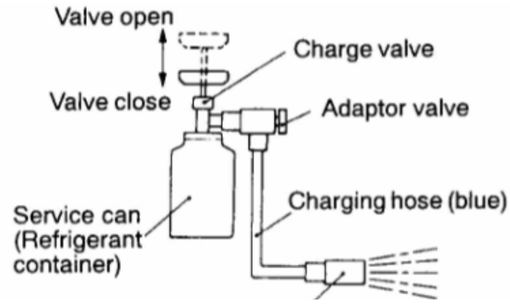


Fig. 18-6

⑴Install the charge valve with the handle turned all the way back (valve open) to the service can.

⑵Install the adaptor valve with the handle turned all the way back (valve close) to the charging valve.。

⑶Connect the charging hose (blue) to the adaptor valve.

⑷Connect the charging hose (blue) to the quick joint (for low-pressure).

⑸Tighten the handle of the charge valve (valve close), and pierce the service can..

⑹Turn the handle of the adaptor valve to bleed the air.（upper operations shown in figure 17-6）。

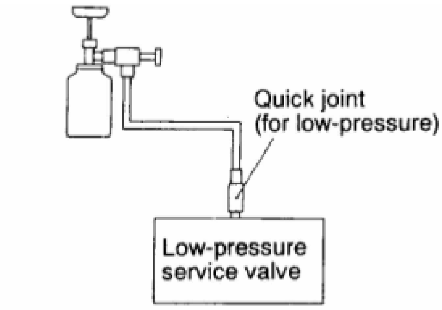


Fig. 18-7

⑺Install the quick joint (for low-pressure) to the low-pressure service valve.（shown in figure 17-7）。

NOTE

Connected the low-pressure service valve to the suction hose.

(8）Start the engine,

(9). Operate the A/C and set the temperature knob at 'COOL'.

（10）Keep the engine speed at 1,800r/min.

⑾.Tighten the handle of the adaptor valve (valve open) to charge and observe volume of refrigerant through the sight glass.

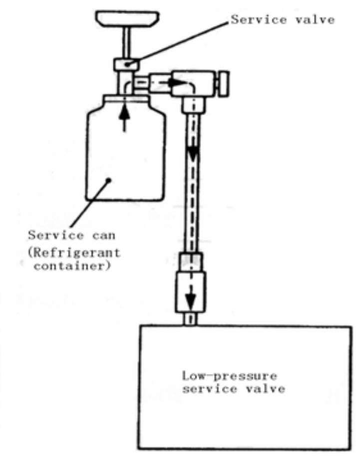


Fig. 18-8

CAUTION

If the service can is placed upside down, liquid refrigerant may be drawn into the compressor, which is damaged by liquid compression. Hold the service can upright to ensure that refrigerant is charged at vapor state.

⑿. After charging with refrigerant, turn the handle of the adaptor valve back all the way (valve closed). Remove the charge joint.

NOTE

If service can is not empty, keep the charge value and the valve of the adaptor close for use next time

8. DISCHARGE **(Fig. 18-9)**

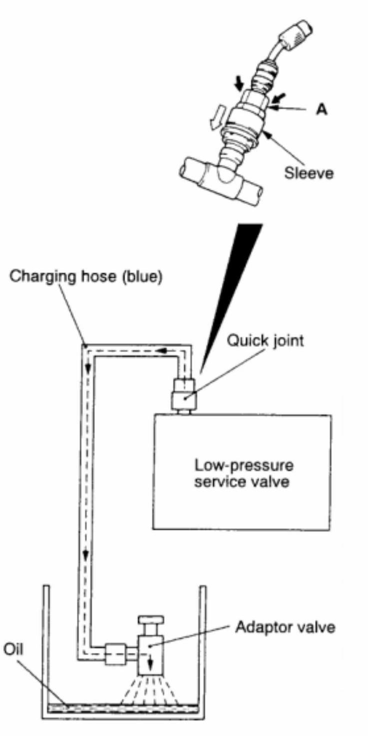


图 18-9

⑴. Run the engine at 1200~1800r/min for about 5 minutes with the A/C operation to return to the oil.。Returning the oil will be more effective while driving.

NOTE
Returning the oil will be more effective while driving.

⑵ Stop the engine.

⑶ Connect the charging hose (blue) to the adaptor valve with its handle turned back all the way (valve closed).

⑷ Connect the quick joint to the charging hose (blue).

⑸ Install the quick joint to the low-pressure service valve.

CAUTION
The low pressure service valve should be connected to the suction hose.

CAUTION
To connect the quick joint, press section "A" firmly against the service valve until a clatter is heard. **When connecting, run your hand along the hose while pressing to ensure that there are no bends in the hose.**

⑹ Place the adaptor valve inside a container and discharge the refrigerant by opening the handle gradually so that oil does not spray out.

NOTE
Any oil remained in the container should be returned to the A/C system.

9 REFILLING OIL

Too little oil will provide inadequate compressor lubrication and cause a compressor failure. Too much oil will increase discharge air temperature.

When a compressor is installed at the factory, it contains stated quantity of refrigerant oil. While the A/C system is in operation, the oil is carried through the entire system by the refrigerant. Some of this oil will be trapped and retained in various parts of the system.

Refill compressor oil when following parts (Table 18-8) are replaced.

Compressor oil NO.: Shown in table 18-3

Table 18-8

Replaced part	Volume
Condenser	20 ml
Front evaporator	20 ml
Roof evaporator	15 ml

A pipe/hose	15 ml
Receiver	10ml

10 PERFORMANCE TEST (Fig. **18-10、18-11、18-12)**

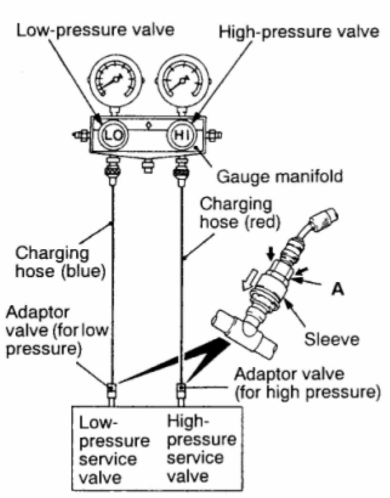


Fig. 18-10

(!) Place the vehicles on a place not subjected to direct rays of the sun.

(2) Close the high and low-pressure valve of the gauge manifold.

(3) Connect the charging hose (blue) to the low-pressure valve and the charging hose (red) to the high-pressure valve of the gauge manifold.

(4) attach the quick joint (for low-pressure) to the charging hose (blue), and the quick joint (for high-pressure) to the charging hose (red).

(5) Connect the quick joint (for low-pressure) to the low-pressure service valve and connect the quick joint (for high-pressure) to the high-pressure service valve.

NOTE

The high pressure service valve is on the discharge hose and the low pressure service valve is on the suction hose..

CAUTION

To connect the quick joint, press section "A" firmly against the service valve until a clatter is heard.

When connecting, run your hand along the hose while pressing to ensure that there are no bends in the hose.

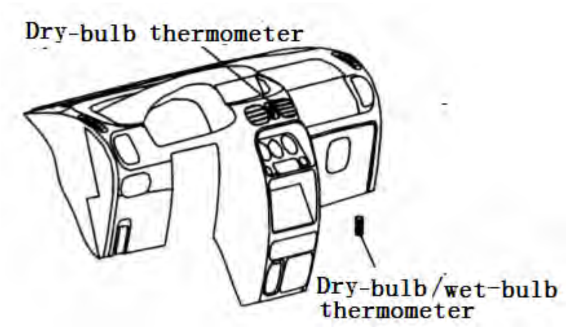


Fig. 18-11

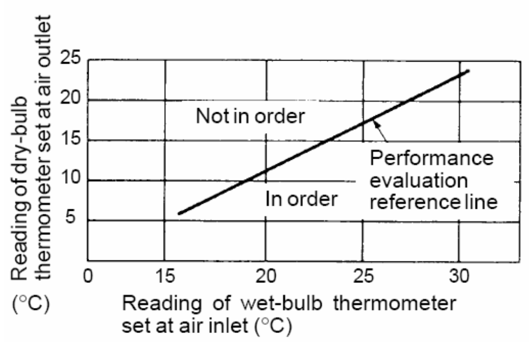


Fig.18-12

(6).Start the engine.

(7).Set the A/C control items as follows:

A/C switch: ON

Mode selection: FACE

Temperature control: MAX COOL

Air selection: RECIRCULATION

Blower switch: HI

(8).With magnetic clutch engaged, keep engine speed at 1800r/min.

(9)The high pressure should be within the specified pressure range of 1667~1765kPa（17~18kgf/cm^2）

NOTICE

If the gauge indicates too high, Cool the condenser by fan. If the high pressure is too lower, cover the the front surface of condenser to adjust ventilation and pressure.

(10).Insert a thermometer in the central air outlet of instrument panel, and install a dry-wet bulb thermometer in air inlet port

CAUTION:

1.Cooled air must be blown to the portion feeling temperature of thermometer。

2..Put the dry-wet ball thermometer to the place where cooled air can not blow directly。

⑾.After temperature of the outlet is stable (operating A/C for 10~15minutes), measure the temperatures of air outlet and air inlet.

⑿.Draw a point using above data on below figure, it is proper if the point is below the judgment line. (see fig 18-12)

11 LEAK-TESTING THE REFRIGENRANT SYSTEM

1) NO REFRIGENRANT

If the system has lost all of its refrigerant charge due to leakage::

⑴.Evacuate the system;(refer to foregoing contents)

⑵.Charge the system with 0.5kg refrigerant;

⑶.Check for leaks;

⑷.Discharge the system;

⑸.Repair leaks;

⑹.Replace receiver.

CAUTION

Receiver units used when replacing must be sealed while in storage. The desiccant used in these units will saturate water quickly upon exposure to the atmosphere. When installing a receiver, have all tools and supplies ready for quick reassembly to avoid keeping the system open any longer than necessary.

⑺. Evacuate and charge system.

2) INSUFFICIENT CHARGE OF REFRIGERANT

If the system has not lost all of its refrigerant charge; locate and repair all leaks. Find the leak (because of an especially low charge) by adding refrigerant to increase the system pressure if necessary. It is possible to repair the leak without discharging the system. Refer to the sequence for correcting low refrigerant level.

3) PIPES TREATMENT AND COUPLINGS

Couplings in the refrigerant tubing or sharp bends in the refrigerant hose lines will greatly reduce the capacity of the entire system. High pressures are produced in the system when it is operating.

Extreme care must be exercised to make sure that all connections are pressure tight. Dirt and moisture can enter the system when it is opened for repair or replacement of lines or components. The following precautions must be observed. The system must be completely discharged before opening any fitting of connection in the refrigeration system. Open fittings with caution even after the system has been discharged. If any pressure is noticed as a fitting is loosened, allow trapped pressure to bleed off very slowly.

A good rule for the flexible hose lines is keeping the radius of all bends at least 10 times of the diameter of the hose.

Sharper bends will reduce the flow of refrigerant.

The flexible hose lines should be routed so that they are at least 80 mm from the exhaust manifold. It is good practice to inspect all flexible hose lines at least once a year to make sure they are in good condition and properly routed.

Unified plumbing connections with O-rings, these O-rings are not reusable.

12 COMPRESSOR NOISE

You must first know the conditions when the noise occurs. These conditions are: weather, vehicle speed, in gear or neutral, engine temperature or any other special conditions.

Noises that develop during A/C operation can often be misleading. For example: what sounds like a failed front bearing or connecting rod, may be caused by loose bolts, nuts, mounting brackets, or a loose clutch assembly. Verify accessory drive belt tension (power steering or alternator).

ADJUSTMENT

(1). Select a quiet area for testing. Duplicate conditions as much as possible. Switch compressor on and off several times to clearly identify compressor noise. To duplicate high ambient conditions (high head pressure), restrict air flow through condenser. Install manifold gauge set to make sure discharge pressure doesn’t exceed 2.070kpa.

(2). Tighten all compressor mounting bolts, clutch mounting bolt, and compressor drive belt. Check to assure clutch coil is tight (no rotation or wobble).

(3). Check refrigerant hoses for rubbing or interference that can cause unusual noises.

(4). Check refrigerant charge. (See “charging system”).

(5). Recheck compressor noise as in step 1.

(6). If noise still exists, loosen compressor mounting bolts and retighten. Repeat step 1.

(7). If noise continues, replace com

13 IDLE-UP OPERATION CHECK

(1). Before check:

- Coolant temperature:80 - 90℃.
- Lamps, electric cooling fan and all accessories:： OFF.
- Transmission: N..

(2). Check that the idle speed is within the standard value.

Standard value：850±50r/min

NOTE
The idle speed is controlled by engine ECU system and should not be adjusted.

(3). The idle speed should be within the standard valve when the A/C is operating.

Standard value：1000±50r/min

18.4 HEATER CONTROL UNIT

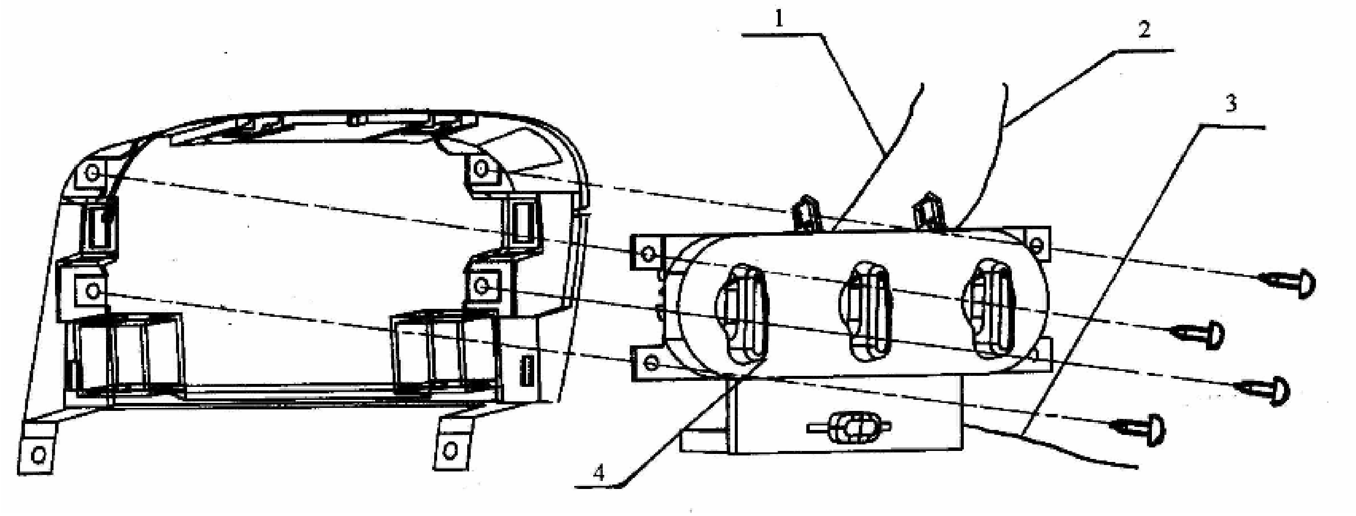


Fig.18-13

1 REMOVAL（Fig.18-13）

1. Disconnect mode cable from mode damper.
2. Disconnect temperature cable from temperature damper.
3. Disconnect fresh air control cable connected from air damper case.
4. Heater control mechanism.

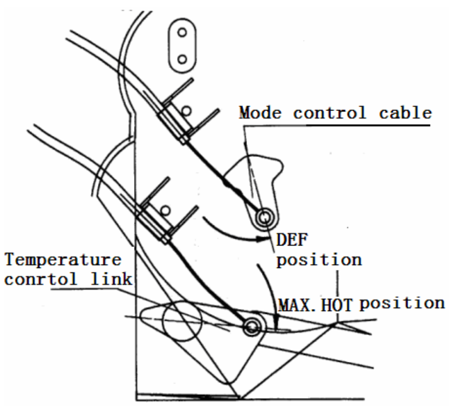


Fig.18-14

2 POINTS FOR INSTALLATION (Fig. 18-14)

1) MODE CONTROL CABLE (Fig. 18-14)

1. Set the heater control unit's blow mode switching knob to the "DEF" position

2. Set the heater unit's blow mode switching damper relay to the "DEF" position (turn the damper relay to the left until it stops) and install the cable.

2) TEMPERATURE CONTROL CABLE

1. Turn the heater control unit's temperature adjustment knob all the way to the" HOT" side.

2. Set the heater unit's air mix door lever to the "MAX HOT" position (turn the damper lever all the way to the right until it stops) and attach the cable.

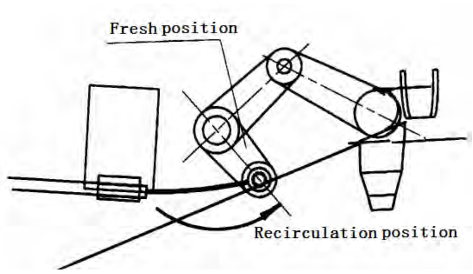


Fig.18-15

3) FRESH AIR CONTROL (FRESH- CIRC SELECTOR) CABLE (Fig. 18-15)

1.Put circulated-fresh control knob of heater control unit to the CIRCULATED position。

2.Put the control lever of Circulated-Fresh control damper of air intake box to the CIRCULATED position(rotate the control lever anticlockwise to its limited position), and attach the cable。

2 INSPECTION FOR BLOWER SWITCH (Fig. 18-16、Table 18-9)

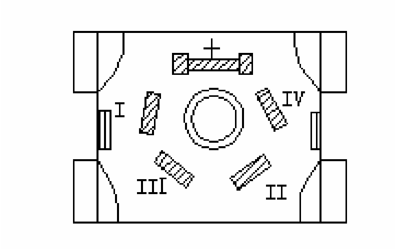


Fig.18-16

Blower switch continuity check Table 18-9

Locations	Terminals				
	+	I	II	III	IV
OFF	○	○			
1	○	—	○		
2	○	—	—	○	
3	○	—	—	—	○

18.5 HEATER, CONNECTING DUCT, DAMPER CASE

- **REMOVAL AND INTALLATION、**

(Connecting duct is just for the vehicle without cooling system)

Preoperations before removal and operations after installation

- Drain and charge coolant（refer to other chapter this manual）
- Removal and installation of instrument panel（refer to other chapter this manual）
- Removal and installation of steering column（refer to other chapter this manual）
- Disconnection and connection of air bag（refer to other chapter this manual）
- Removal and installation of heater control unit（refer to foregoing contents this chapter）
- Disconnection and connection of connectors of I/P harness
- Removal and installation of heater water hoses

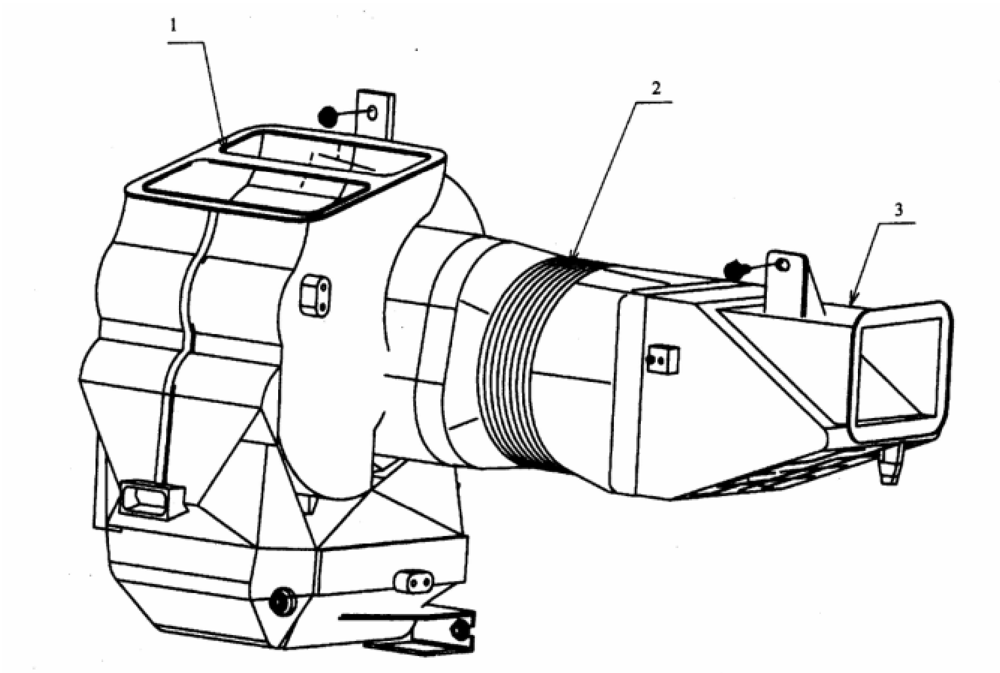


Fig. 18-17

1 REMOVAL STEPS (Fig. 18-17)

1． Heater   2. Joint duct   3. Damper case

2 INSTALLATION

Reverse the removal sequence to install the parts

3 INSPECTION

Resistor check t (Fig. 18-18)

Standard values：(Table 18-9)

	1
2	3

Fig. 18-18

Table 18-9

Terminal to terminal	Resistance(Ω)
H-M（No.1－3）	0.8
H-L（No.2－3）	2.5
L-M（No.1－2）	1.7

18.6 FRONT EVAPORATOR

- **REMOVAL AND INSTALLATION**

Preoperations before removal and operations after installation

- Drain and charge coolant（refer to other chapter this manual）
- Removal and installation of instrument panel（refer to other chapter this manual）
- Removal and installation of steering column（refer to other chapter this manual）
- Disconnection and connection of airbag（refer to other chapter this manual）
- Removal and installation of high and low pressure pipe and connector of thermo-resistance.

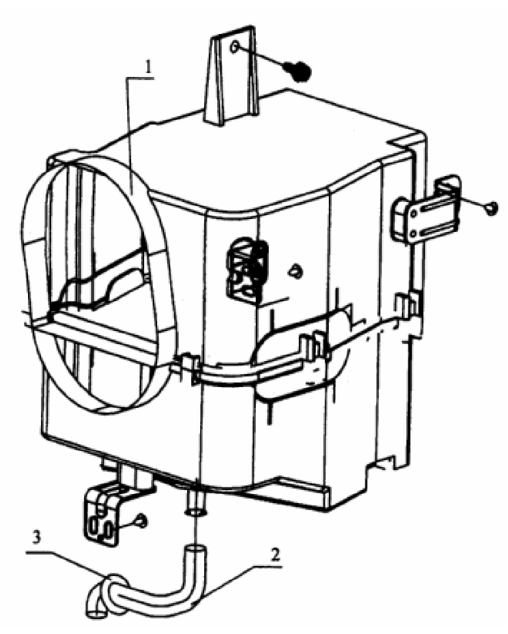


Fig. 18-19

1 Front evaporator　　2 Front drain hose　　3 Grommet for drain hose

18.7 ROOF EVAPORATOR AND ITS COVERS

● **REMOVAL AND INSTALLATION**

Preoperations before removal and operations after installation

- Drain and charge coolant（refer to the chapter this manual）
- Removal and installation of high and low pressure pipe and connector of the harness.

1 PROCEDURE OF REMOVAL（see Fig. 18-20）

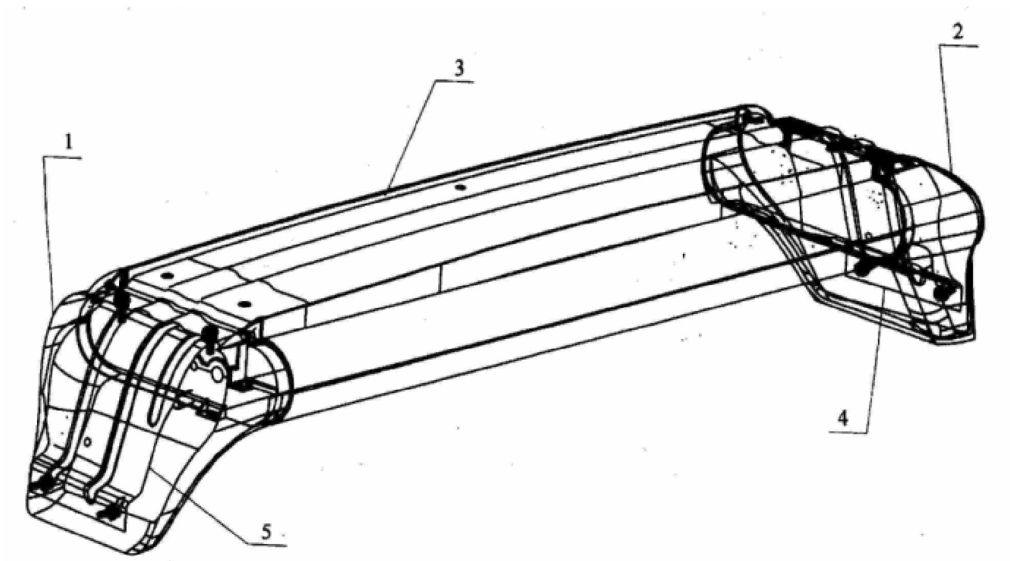


图 18-20

1 Left cover 2 Right cover 3 Roof evaporator assembly 4 Right bracket 5 Left bracket

18.8 COMPRESSOR

● **REMOVAL AND INSTALLATION**

Preoperations before removal
- Drain refrigerant (see the chapter before)
- Disconnect magnetic clutch connector.
- Remove suction hose and discharge hose from compressor

operations after installation
- Charge refrigerant (see the chapter before)
- Inspect tension of the belt for driving compressor (refer to adjust engine)

1 REMOVAL STEPS (Fig.18-21)

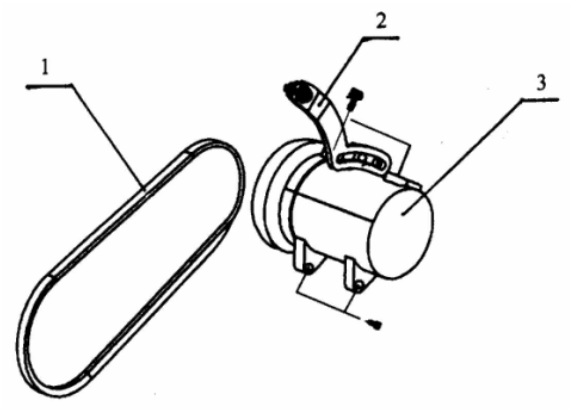


Fig.18-21

1 Compressor belt
2 Compressor adjusting bracket
3 Compressor

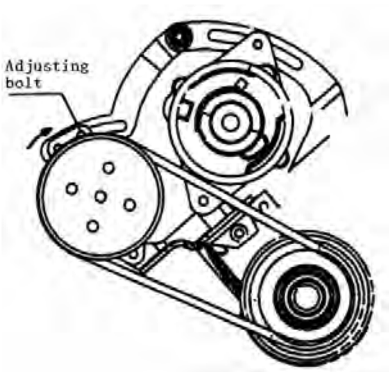


Fig.18-22

2 POINTS FOR REMOVAL

1) Removal of hoses and pipes

To prevent dust or others from entry, plug the condenser、compressor and expansion valve nipples.

CAUTION

Cap the opened fittings so that moisture may not enter compressor oil and receiver

2) Removal of the drive belt（shown in figure 18-22）

⑴Loosen the mounting bolt.

⑵Loosen the adjusting bolt and remove the drive belt.

3) Removal of compressor

Take care not to spill any compressor oil when removing the compressor

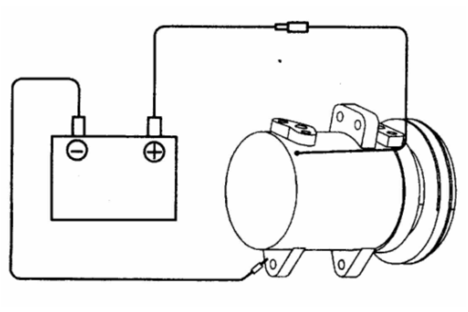


Fig. 18-23

3 OPERATION CHECK FOR MAGNETIC CLUTCH （Fig. 18-23）

Connect the compressor connector terminal to the battery positive (+) terminal and ground the battery's negative (-) terminal to the compressor unit. At that time, the magnetic clutch should make a noticeable operating sound.

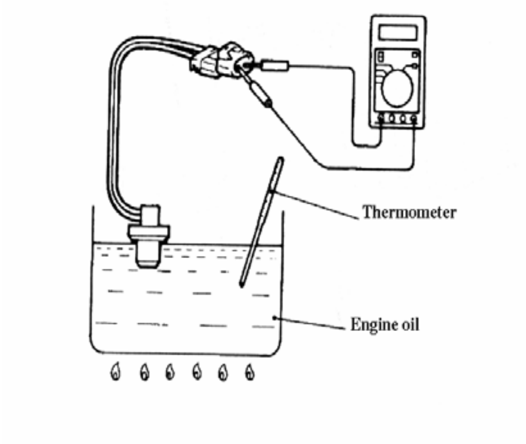


Fig 18-24

4 Refrigerant **temperature switch**

1. Dip the metal part of the Refrigerant temperature switch into engine oil and warm up the oil（Fig. 18-24）。

2. When the oil temperature reaches the standard value, check continuity by a tester between the terminals.

Standard value:

Continuity　　Slightly below 150℃< JIANSHE >
　　　　　　　Slightly below 130℃<AOTECAR>

No continuity　150℃ or higher< JIANSHE >
　　(until temperature falls to 130℃ when OFF)
　　130℃ or higher<AOTECAR>
　　(until temperature falls to 105℃ when OFF)

CAUTION
Do not heat to temperature more than necessary.

18.9 CONDENSER

- **REMOVAL AND INSTALLATION**

Preoperations before removal and operations after installation
• Drain and charge refrigerant (see the chapter before)
• Disconnect and connect magnetic clutch connector.
• Remove and install the high and low pressure pipes from condenser.

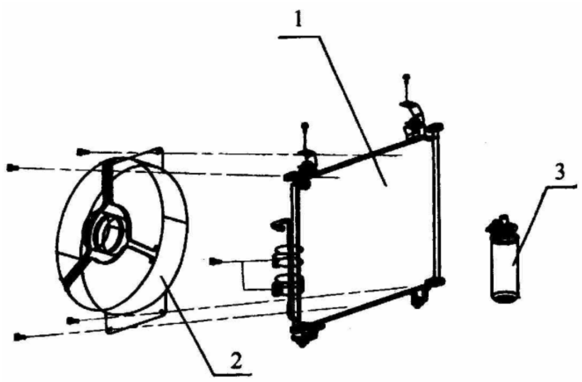


Fig. 18-25

1 REMOVAL STEPS (Fig. 18-25)

1 Condenser 2 Condenser motor(applying to the vehicle with small radiator) 3 Receiver

2 POINTS FOR REMOVAL

1) **Removal of hoses and pipes**

As soon as the hoses and pipes are disconnected, cap the opened fittings of the condenser and pipes so that dust and foreign impurities may not enter.

CAUTION
Cap the opened fittings so that moisture may not enter compressor oil and receiver

18.10 AIR CONDITIONING PIPING

- **REMOVAL AND INSTALLATION**

Preoperations before removal and operations after installation • Refrigerant drain and charge (refer to this chapter before）

1. REMOVAL STEPS(see Fig18-26)

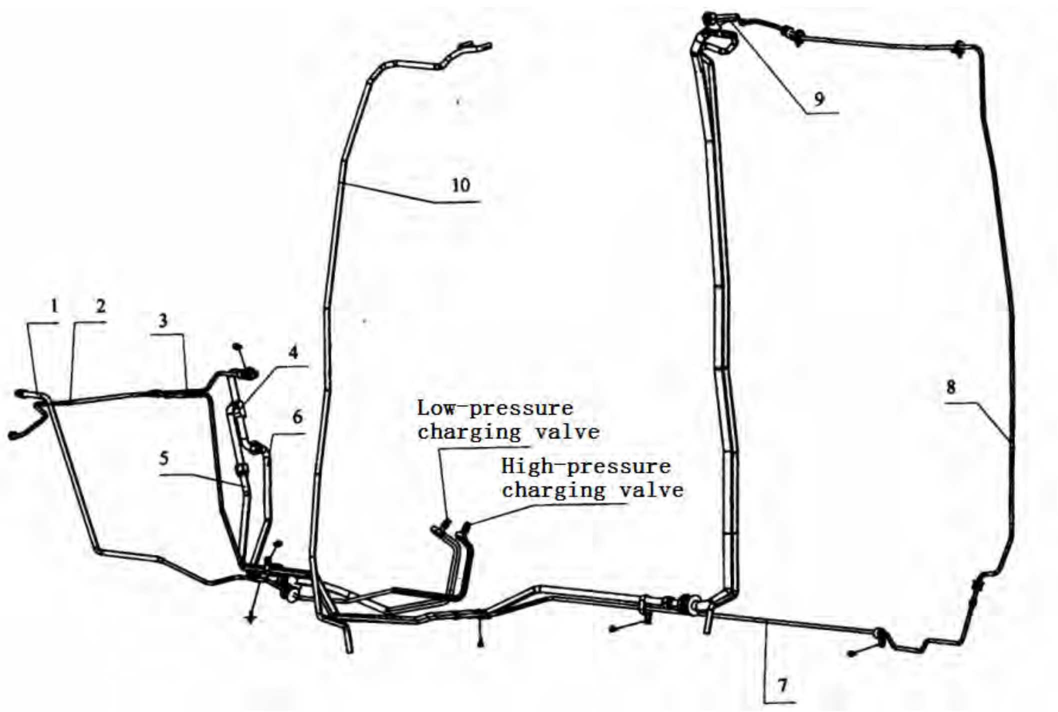


Fig. 18-26a
(Dual evaporator A/C)

1 Compressor discharge hose 2 Liquid pipe, 3-way 3 Pipe A, liquid 4 Pipe, low pressure 3-way 5 Low-pressure pipe 6 Compressor suction hose 7 Pipe B, liquid 8 H/P hose, roof evaporator 9 L/P hose, upper evaporator 10 Drain hose for roof evaporator

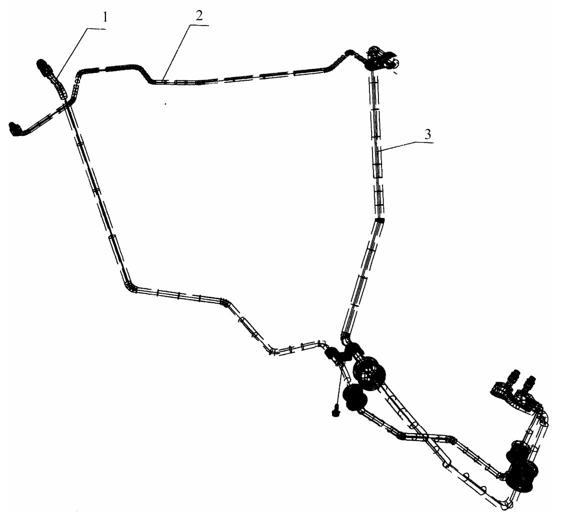


Fig. 18-26b
(Single-front evaporator A/C)

1 Compressor discharge hose 2 Pipe, liquid 3 Compressor suction hose

Nuts and bolts used is specified on dimension and torque in Table 18-10

Table18-10

Location	Nut or bolt	Tightening torque
Compressor discharge hose to condenser	Nut M22	19.6N.m~24.5N.m
Receiver to 3-way liquid pipe	Nut M16	11.8N.m~14.7N.m
3-way liquid pipe to Liquid pipe A	Nut M16	11.8N.m~14.7N.m
Liquid pipe A to Liquid pipe B	Nut M16	11.8N.m~14.7N.m
Liquid pipe B to Roof evaporator H/P hose	Nut M16	11.8N.m~14.7N.m
Roof evaporator H/P hose to Roof evaporator	Nut M16	11.8N.m~14.7N.m
Roof evaporator to Upper evaporator L/P hose	Nut M22	19.6N.m～24.5N.m
Upper evaporator L/P hose to low-pressure pipe	Nut M22	19.6N.m～24.5N.m
Low-pressure pipe to Low pressure 3-way pipe	Nut M22	19.6N.m～24.5N.m
Low pressure 3-way pipe to compressor suction hose	Nut M22	19.6N.m～24.5N.m
Plates of compressor suction and discharge hoses to compressor	Bolt M6	6N.m～12N.m
	Bolt M8	16N.m～26N.m

2 POINTS FOR REMOVAL

DISCONNECT PIPING

As soon as the hoses and pipes are disconnected, cap the opened fittings of the condenser and pipes so that dust and foreign impurities may not enter.

CAUTION

Cap the opened fittings so that moisture may not enter compressor oil and the receiver

18.11 DUCTS

- **REMOVAL AND INTALLATION**

Preoperations before removal and operations after installation

- Removal and installation of instrument panel（refer to other chapter this manual）
- Removal and installation of steering column（refer to other chapter this manual）
- disconnection and connection of airbag（refer to other chapter this manual）

1 REMOVAL STEPS (Fig. 18-27)

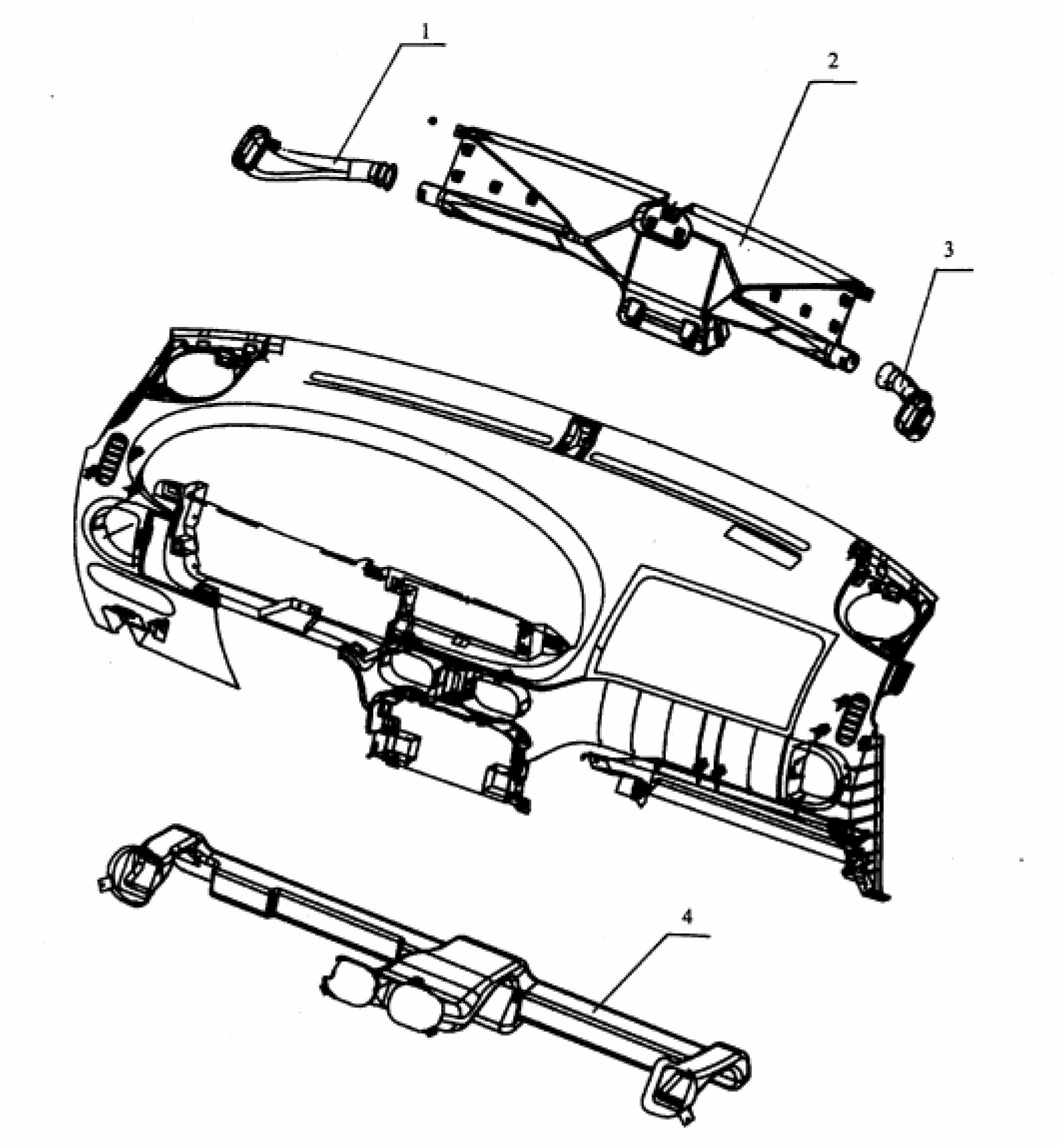


Fig. 18-27

1 Left defrosting duct 2 Defrosting nozzle 3Right defrosting duct 4 Ventilation duct

18.12 HEATING WATER HOSES

- **REMOVAL AND INTALLATION**

Preoperations before removal and operations after installation • Drain and charge coolant（refer to other chapter this manual）

1 REMOVAL STEPS (Fig. 18-28)

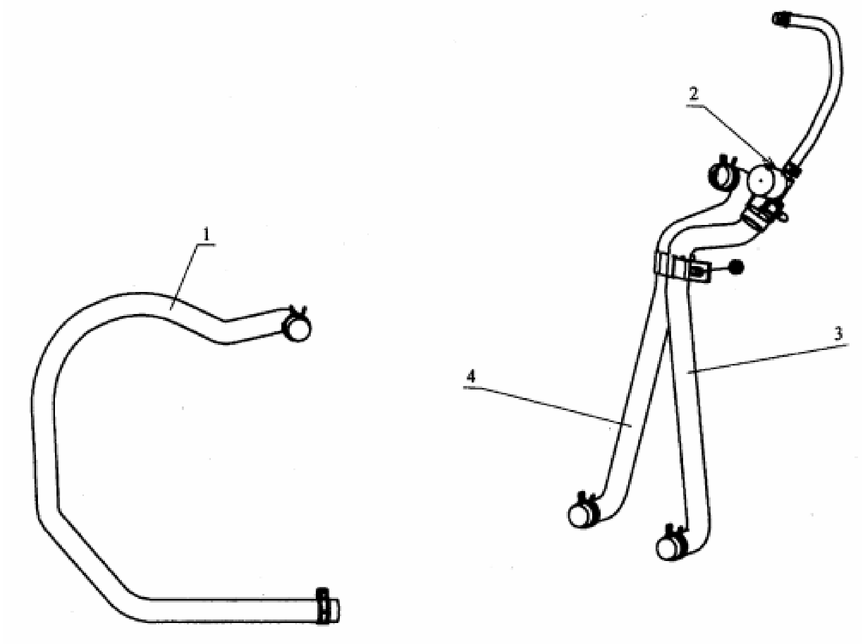


Fig. 18-28

1 Hose, engine discharge water 2 Pipe assembly, 3-way 3 Hose, heater discharge water 4 Hose, heater intake water

19 THE BODY ACCESSORIES

19.1 Installation and removal of windshield glass

- General tools

1 Piano wire
2 The sponge (used for applying the primer).
3 The gauze (used for applying the unleaded gasoline).
4 The unleaded gasoline (used for cleaning the surfaces).
5 The spatula (used for mending the adhesion surface).
6 Sealant gun (used for applying the adhesive).
7 Vacuum glass holders (2 pieces, used for moving the glasses).
8 The penknife (used for cutting the adhesive precisely).
9 The awl (used for making a hole in the sealant).
10 The snap plier (used for helping the piano wire to go through the adhesive).
11 The adhesive and primer (the primer is used to apply on the surface of glass and body).

- Windshield glass installation

1. The body:

Clean the adhesive surface: cut off the solidified adhesive till the remaining adhesive is 2 mm thick or less, then to clean the adhesive surfaces with the unleaded gasoline, let it dry for more than 10 minutes.

Apply the primer: apply the primer to the adhesion surfaces sufficiently, and let it dry for more than 10 minutes.

2. Windshield glass:

1) For the reused glass

Clean the adhesion surface: cut off the entire solidified adhesive, then to clean the adhesion surfaces with the unleaded gasoline, let it dry for more than 10 minutes before installation.

2) For the new glass

Clean the adhesion surface: clean the adhesion surfaces with the unleaded gasoline let it dry for more than 10 minutes before installation.

Apply the primer: apply the primer on the adhesion surfaces sufficiently (in specified area), and to dry for more than 10 minutes.

Apply the adhesive: apply the adhesive evenly and sufficiently on the surface of inner side of glass within 30 minutes after the primer has been applied.

3. Install windshield glass:

By using the vacuum glass holder, mount the glass on the body frame after the adhesive has been applied, and to make sure that they match completely. If the adhesive is squeezed out, using a spatula to remove the redundant adhesive, then, to clean the glass and body with the unleaded gasoline.

4. Check water leakage: Carry out the shower test for one hour after the glass has been installed and to make sure that there is no water-leakage.

● The solidifying time is needed, so as to get better strength:

After operation, the time for the adhesive solidifying is below:

During winter: About 10℃, for 6 ~ 8 hours.

During spring: About 20℃, for 3 ~ 4 hours.

During summer: About 30℃, for 1 ~ 2 hours.

The time for the adhesive solidifying is different because of environmental temperature. The lower temperature it is, the longer time will it take. The time can be shortened by using infrared lamp to irradiate the adhesive to raise the temperature.

Notice:
(1)If the temperature is too high, the bubble will create in the adhesive. The temperature should be controlled below 100 ℃.
(2)If the glass is moved before the adhesive solidified completely, the adhesive may be destroyed, so pay more attention to it.

The primer

The primer can strengthen the adhesive effect between glass and gummed surface.

Notice:
Only the specified type primer can be used.

The specifications of adhesive and primer:

(1)The adhesive will be easy to become ineffective after produced six months later, so buy it when need.

(2)The adhesive and Primer should be stored in the cold and dark place.

(3)The adhesive can solidify when it mix with moisture in the atmosphere. Open it just before using. If there is some adhesive left, to use it in the future.

(4)the container should be shaken until the primer become evenly before using. The primer could not be used if there is suspension, deposit.

(5)You must clean the skin with unleaded gasoline immediately if touching the adhesive or the primer. And then, to clean the skin with the soap.

(6)Keep the primer away from the fire because it is combustible, Place it in ventilated place.

- The removal sequence of windshield glass as shown in Fig. 19-1.

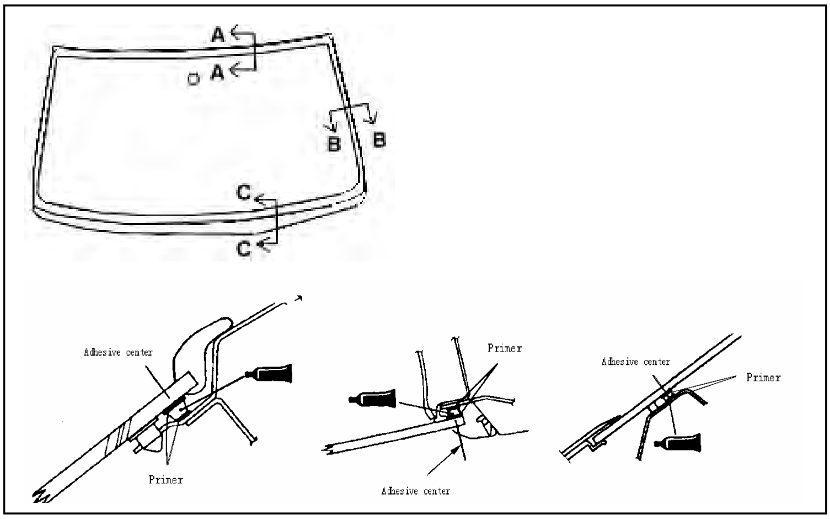


Fig. 19-1

Removal key sequence::

1 In order to protect the body (paint surface), apply the cloth tape on the body areas around the installed windshield.

2 Cut off a part of weatherstrip with a knife.

3 Make a small hole in the adhesive with a sharp awl.

4 Pass the piano wire through the hole from the inside of vehicle.

5 Along the windshield, pulling the piano wire inside and outside alternately to cut the adhesive.

Notice:
The piano wire can not touch the edge of the windshield.

6 Make alignment mark on the body and windshield, then, using vacuum glass holder to remove the windshield from the body as shown in Fig. 19-2.

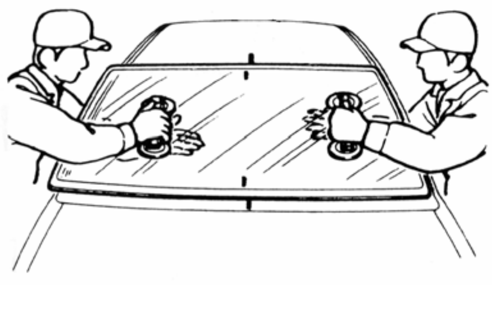


Fig. 19-2

19.2 Installation and removal of seats

The seats can be classified front, middle and rear seat. The front seats are classified driver’ s seat and passenger’ s seat and it can be adjust frontward and backward with slide guide adjuster. The middle seats have two optional state, ①two single seat left and right; ②Fold seat side double seat. The front and middle line seats are equipped with adjuster which can adjust the angle of seat-back. The backrest of rear seat can be folded forward.

● 1 The Installation and removal of driver’ s and passenger’ s seats

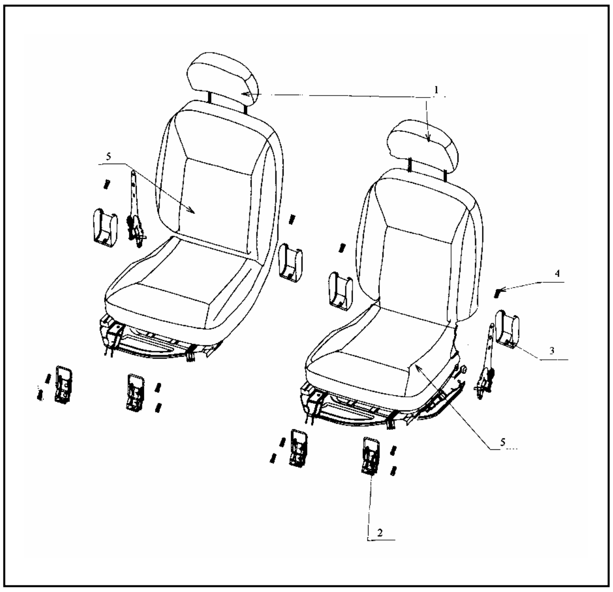


Fig. 19-3

(1) The removal sequence of driver’ s (passenger’ s) seat as shown in Fig. 19-3:

①Remove the headrest
②Open the seat lock
③Dismount the luster
④Unscrew the bolts
⑤Dismount the seat

(2) The installation key sequence of driver’ s (or passenger’ s) seat

The installation sequence is reverse to the removal sequence when the driver’ s (or passenger’ s) seat is unloaded.

(3) Installation of seat luster is shown in Fig. 19-4:

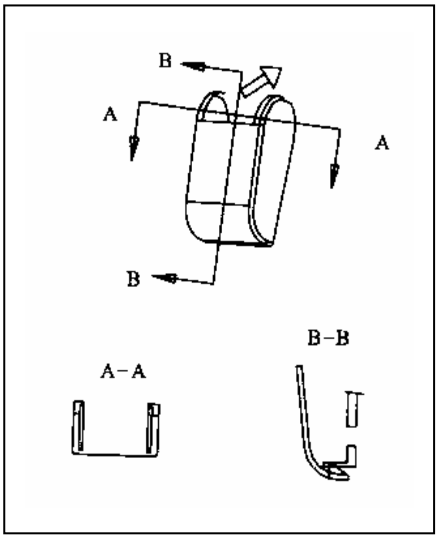


Fig. 19-4

2 Removal and installation of the middle row seat

(1) The removal sequence of middle row seat is shown in Fig. 19-5、19-6:

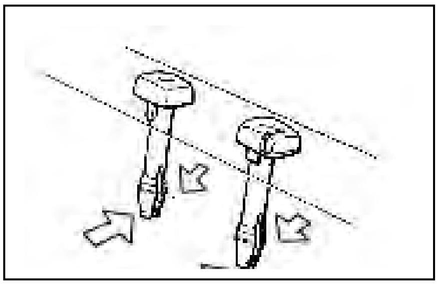


Fig. 19-5

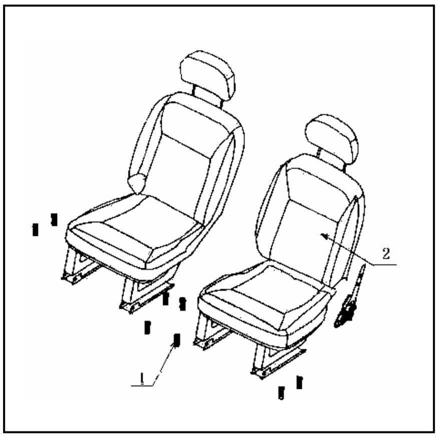


Fig. 19-6

①Unscrew the bolts.

②Dismount the middle row seat.

(2) The installation sequence of the middle row seat is reverse to the removal sequence.

3 Removal and installation of the rear row seat

(1) The removal sequence of rear row seat is shown in Fig. 19-7:

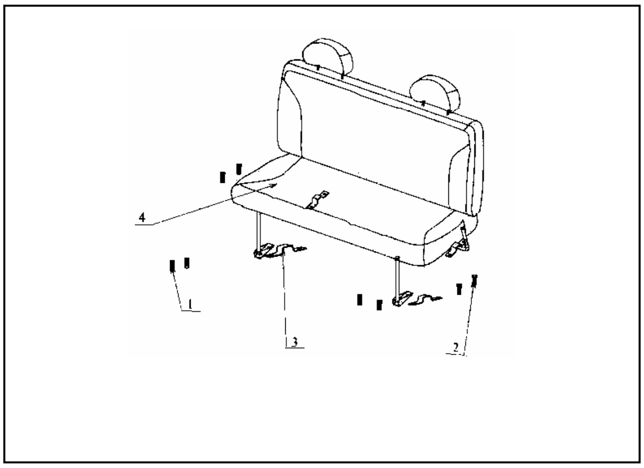


Fig.19-7

① Unscrew the front mounting bolts ②Unscrew the rear mounting bolts ③ Take down the mount part ④Dismount the rear row seat

(2) The installation sequence of the rear row seat is reverse to the removal sequence.

19.3 The installation and removal of headliner

1 The installation and removal of the headliner as shown in Fig. 19-8:

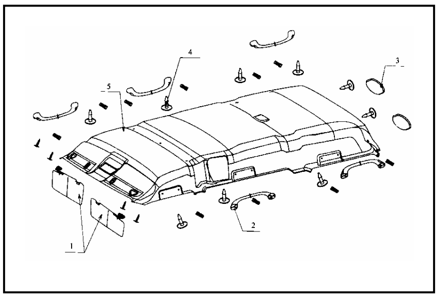


Fig.19-8

(1) The removal sequence:

1 Sunvisor 2 Handle 3 The adjusting cap of tail door hinge
4 The clip 5 Headliner

(2) The installation sequence is reverse to the removal sequence

19.4 The installation and removal of safety belt

The safety belt is a kind of belt structure preserver that can prevent or relieve the occupant injure when the vehicle brake emergent or be impacted. Front safety belt consist of front retractor、front buckle.

- Removal and disassembly of safety belt assy.

①Remove the ornament cover side the seat, bare the buckle bolts, unscrew this bolt and then remove the buckle.

② Open the cover of safety belt upper fixing point, unscrew the bolt to remove the mesh belt upper.

③ Remove the center pillar lower trim for deluxe trim first, then remove the spring collar and guiding axle which used for guide the mesh belt. Open the ornament cover of the safety belt fixing point upper, unscrew the bolt to remove the mesh belt upper, (Only remove the retractor cover when install the under grade trim) unscrew the bolt which used to fix the retractor then to remove the retractor.

④Unscrew the mesh belt lower mounting bolt located on the floor cross member then remove the front safety belt assy.

- Installation of front safety belt assy

①Fix buckle with tighten the 7/16 inch bolt on seat side, tightening torque is 34-54N.M, cover the ornament cover by the seat side.

② Fix the retractor on the upper point of the body with 7/16（inch） bolt, install the safety belt cover.

③ Fix the safety belt anchor on the center pillar inside panel with 7/16 inch bolts. Install the front retractor(standard trim); for deluxe trim, install the retractor on the center pillar inside panel with 7/16 inch bolts, let the mesh belt go through the safety belt guide bracket on the body, then install the guide axle and spring collar and cover the center pillar trim.

④ Install the belt on the lower fix point to the floor front cross member by 7/16 inch bolt.

19.5 Installation and removal of the side window assy

The function of side window assy is widen the passenger's view, keep the nice airing. It consists of side glass, the front dustproof strip of side glass, side window grommet, flanged nut, bolts. The side window assy can reach the airing effect through the side window lock and hinge to open the glass narrow angle. The structure is shown in Fig. 19-9.

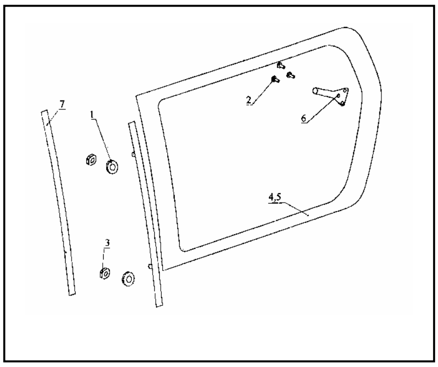


Fig. 19-9

1、Grommet 2、Bolt 3、Flanged nut 4、5 Side glass 6、Side window lock 7、Side window front dustproof seal

Removal and disassembly

(1)Removal the rear pillar inner trim on the body upper first for the deluxe trim (2) Unscrew three M6 screw fixed for side window lock with special tool, and then removal the side window lock from the body.

(3)Remove the C pillar trim upper forcibly for the deluxe trim (Remove the Welch plug on the C pillar panel from the body for the standard trim), then you can notice two pass holes located on the side panel inner, unscrew two nuts (correspond to the order number as shown in figure) with special tool, at this moment please be careful to hold the glass to remove the side window assy.

(4)Removal the side glass dustproof seal.

- Installation

(1)Install the side window grommet on the side panel outer, and adjust it to the fitting position.

(2) Pass through the hinge bolts of side window from the grommet, then fix it on the side panel outer with two nuts.

(3)Fix the side window lock on the side panel inner with three M6 nuts, the tightening torque is 10N.m

(4)Test the side window assy. Be sure the clearance between side window glass and side panel outer is equal, and the whole mechanism work agility.

(5)Install the C pillar inner trim and rear pillar inner trim for the deluxe trim. Plug two Welch plug to the fitting position for standard trim.

19.6 Installation and removal of the slide door upper guide rail

The rail upper has arc shape rail track line, and the slide door can move forward and backward by bracket and truckle to achieve door open and close. Slide door assy consists of upper guide rail and fixing bolts, the structure is shown in Fig.19-10 。

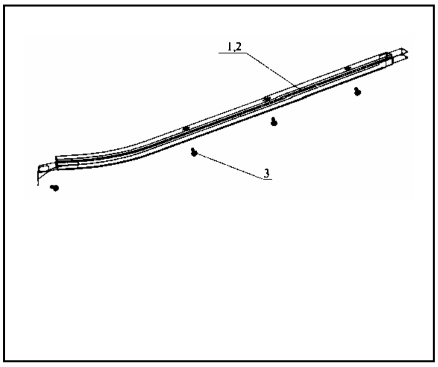


Fig.19-10

1、2; Upper guide rail assy　3; Bolt

Removal and disassembly

Unscrew four M6X16 bolt fixed for the upper guide rail assy to remove it.

Installation

①Install the upper guide rail assy on the rail upper seat of the body with six M6X16 bolts;

②Apply a little lubricating oil after installation, adjust the slide door moving along the rail to insure the door open and close agility.

The installation sequence is reverse to the removal sequence.

19.7 Installation and removal of the slide door center guide rail

The slide door move forward and backward by the bracket and truckle along the arc shape guide rail to achieve the slide door open and close. It consists of center guide rail assy, center guide rail cover, stopper and seven kinds of standard part as shown in Fig.19-11.

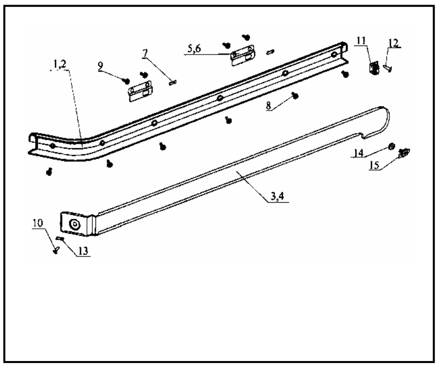


Fig.19-11

1、2 Center guide rail　3、4 Center guide rail cover　5、6 Center guide rail bracket 7、clip 8、profiled screw 9、Bolt assy　10、Tapping screw　11、Center guide stopper 12、Screw 13、Spring clip 14、Flanged nut 15、card bolt

Removal and disassembly

(1)Remove the rear quarter trim(Only remove the Welch plug for standard trim). Unscrew the flange nut fixing for center guide rail cover located at center guide rail rear inside body.

(2)Unscrew the center guide rail cover screw to remove it by forward slip forcibly.

(3)Unscrew four M6 screw fixing for center guide rail bracket to remove this bracket from the body.

(4)Remove center guide rail by unscrew six M6X18 bolts on it.

(5)Remove stopper unscrew M5X14 screw fixing for this stopper.

- Installation

(1) Mount center guide rail assy with six M6X18 bolts on the center guide rail seat of the body.

(2)Mount center guide rail bracket with four M6 bolts on body outer panel, fix spring clip to the bracket.

(3)Mount the stopper on the body with M5X14 screw.

(4)Put the center guide rail cover and center guide rail in the fitting position, center guide rail go slightly and slide backward into the spring clip, adjust it to the fitting position.

(5)Mount center guide rail cover rear on the body mounting hole with M5 nut from the outer body, install the rear quarter trim(Only plug the Welch plug for the standard trim).

(6)Mount the center guide rail cover to the body from outside with spring clip.

(7)Apply a little lubricating oil inside the center guide rail slot, adjust slide door to move along the rail, be sure the door open and close agility.

19.8 Installation and removal of the side panel inner trim assy

The function of side panel inner trim is beauty, heat insulation, cold insulation, absorbing noise, shockproof. It consists of A pillar inner trim assy, center pillar inner trim, rear side panel inner trim and tail door sill garnish. The side panel inner trim is fixed to the body inside by tapping screw, plastic clip, spring clip as shown in Fig.19-12(Deluxe),19-13(standard).

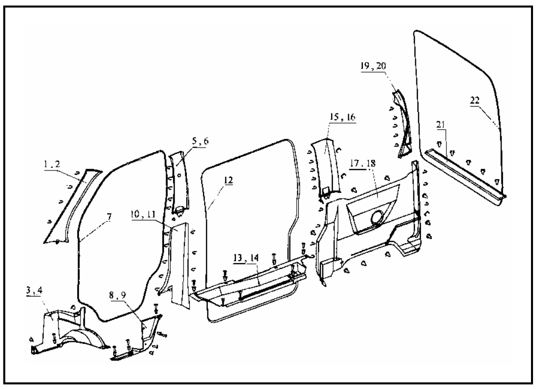
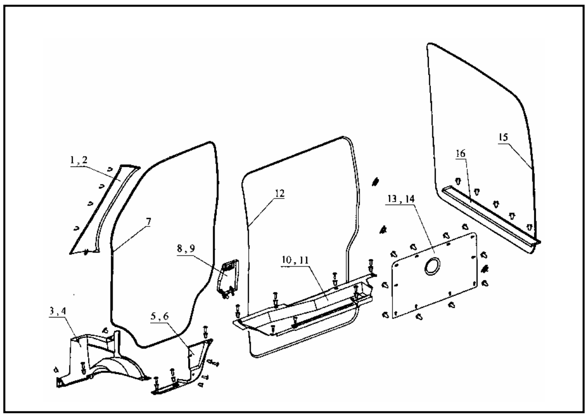


Fig. 19-12

1、2 A pillar inner trim upper 3、4 A pillar inner trim lower 5、6 center pillar inner trim upper 7、Front door wetherstrip 8、9 Front door sill garnish 10、11 center pillar inner trim lower 12、Slide door wetherstrip 13、14 Slide door sill garnish 15、16 C pillar inner trim assy 17、18 Side panel inner trim assy. 19、20 Rear pillar inner trim 21、Tail door sill garnish 22、Tail door wetherstrip



1、2 A pillar inner trim upper 3、4 A pillar inner trim lower 5、6 Front door sill garnish 7、Front door wetherstrip 8、9 Front retractor cover 10、11 Slide door sill garnish 12、Slide door wetherstrip 13、14 Rear side panel inner cover 15、Tail door wetherstrip 16、Tail door sill garnish

Removal and disassembly

⑴ Deluxe trim

①Remove A pillar inner trim upper forcibly.

② Unscrew five tapping screw to remove front door sill garnish.

③Pull out snap fastener, then pull out A pillar inner trim lower upwards.

④Pull out center pillar inner trim lower forcibly from the body, remove the clip lower to pull out center pillar inner trim upper.

⑤Remove slide door sill garnish by remove it’s fixing tapping screw and combinatorial clip.

⑥Pull out tail door sill garnish from the body forcibly.

⑦Remove the Welch plug under the rear side panel inner trim , remove the rear side panel inner trim from the body forcibly.

⑧Remove the combinatorial clip and Welch plug , then pull out C pillar inner trim from the body.

⑨Remove the rear pillar inner trim from the body.

⑵Standard trim

① Remove A pillar inner trim upper forcibly.

② Unscrew five tapping screw to remove front door sill garnish.

③ Pull out snap fastener, then pull out A pillar inner trim lower upwards.

④ Remove the clip fixing for front retractor cover , then to pull out the retractor upwards from the front floor.

⑤Remove the tapping screw and combinatorial clip, then to remove slide door sill garnish.

⑥Pull out rear side inner cover and tail door sill garnish form the body forcibly, remove two Welch plug from body C pillar , then to pull out another Welch plug from rear body side, rear inner cover.

- Installation

Reverse the removal sequence to installation and disassembly. Install plastic clip and spring clip into inner trim hole rear first, then face inner trim to body fitting hole position, knock it with wood hammer till install reliable.

19.9 Installation and removal of front door glass, front window regulator

Removal sequence

(1) Inside panel bezel

(2) Bracket of power window regulator switch (Power window regulator state)

(3) Window regulator (manual regulator state)

(4) Inner handle (for standard trim)

(5) Inner trim (including inner waist seal)

(6) Waterproof film

(7) Outer waist seal

(8) Clips for fixing glass

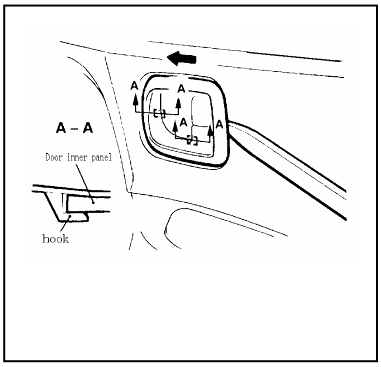
(9) Take out the glass from the door by pull glass rear side and turn forward to a certain angle.

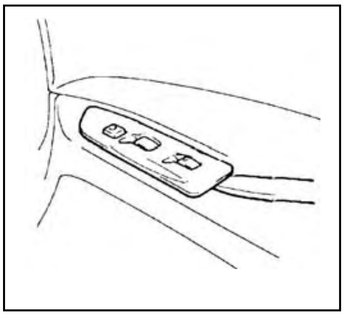
(10) Window regulator fixing screw.

Disassemble operation key points

(1) Unscrew the inner handle bezel fixing screw, slide the inner handle bezel along the direction of arrow by hand or tool as shown in Fig.19-14.

(2) Prize up the front and rear side of power regulator switch bracket by hand or tool, remove the power regulator switch bracket as shown in Fig.9—15.





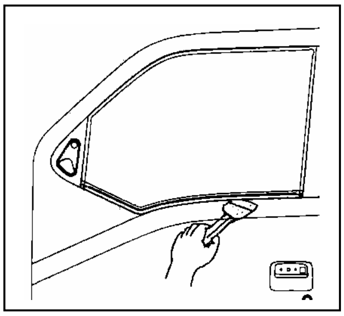


Fig. 19-14 Fig. 19-15 Fig. 19-16

(3) After the glass go down, to remove the outer waist seal by using spatula covered with cloth-tape(or screwdriver), and then to remove the clips of the glass fixation as shown in Fig. 19-16.

- Inspection

(1) Check if window regulator gear worn or damaged.

(2) Check if window regulator works normally.

Installation

Reverse the removal sequence to install the glass regulator and glass, but be sure to pay attention to the following points:

(1) Apply lubricant grease to sliding area of regulator.

(2) After installation of glass and regulator, adjust the glass reclining angle by adjusting the position of regulator short sliding bracket at the double holes of inner panel. Be sure that the depth of glass side inserting the weather-strip is equal.

19.10 Removal and installation of front and slide door lock

1. Front door lock as shown in Fig. 19-17:
2. Slide door lock as shown in Fig. 19-18:

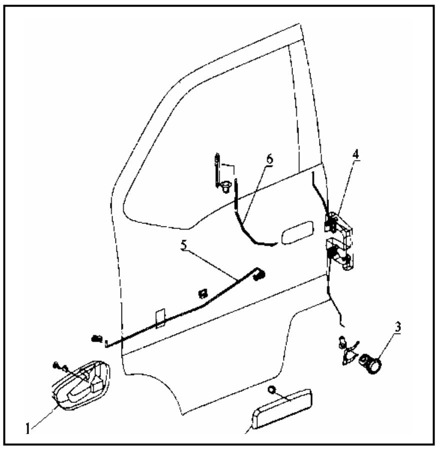


Fig. 19-17

1 Inner handle assy; 2 Outside handle assy
3 Lock, key, cylinder
4 Latch assy; 5 rod of inner handle
6 Lift bar

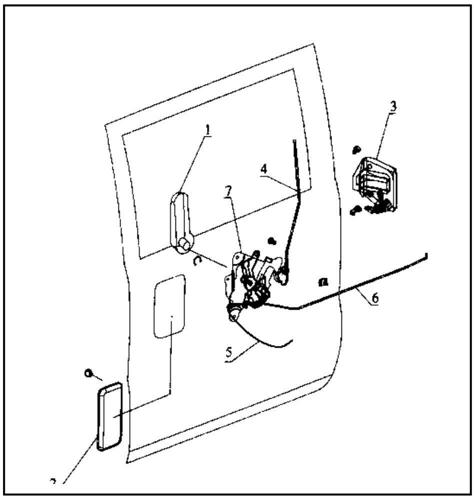


Fig. 19-18

1 Inner handle assy; 2 Outside handle assy
3 Latch assy 4 Lift bar
5 Outside handle cable; 6 Transfer bar
7 Driving transmission

- Removal Sequence

(1) Inner handle bezel

(2) Power window regulator switch(for power window);

(3) Regulator handle(for manual regulator);

(4) Door inner handle; (standard state)

(5) Door trim(including inner waist seal)

(6) Waterproof film

(7) Door inner, outer rod assy and latch assy.

- Installation

The installation sequence is reverse to the removal sequence.

- Installation service key points

(1) Connect the rod "1" with outer handle"2", keep "A" =3.7±1.5mm(see Fig.19-19).

(2) Pay attention to the following items to install inner handle:

a. Insert the clip into hole of inner handle.

b. Install the rod to the inner handle.

C. Install the inner handle to the inner panel.

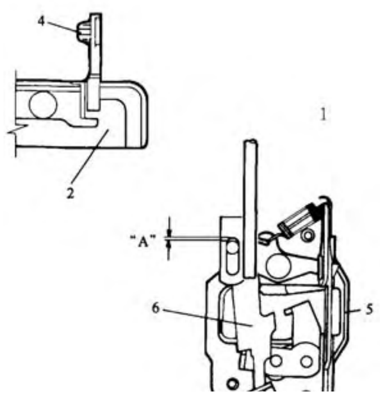


Fig. 19-19

1- Rod of outer handle; 2- Outer handle; 3- Clip;

4- Outer door lever; 5- Door latch A=3.7±1.5mm

3 Door striker

In order to move the door striker position forward or backward, increase or decrease the number of shims inserted between the body and the striker to adjust it. The dimension "D" should be adjusted to 12~14mm, as shown in Fig.19-20. Move the door latch striker up or down so that its shaft is aligned with the center of the hook as shown in Fig.19-21.

Notice:

The striker should be placed level and moved vertically. Do not adjust the door latch.

Apply oil or grease to striker joints periodically.

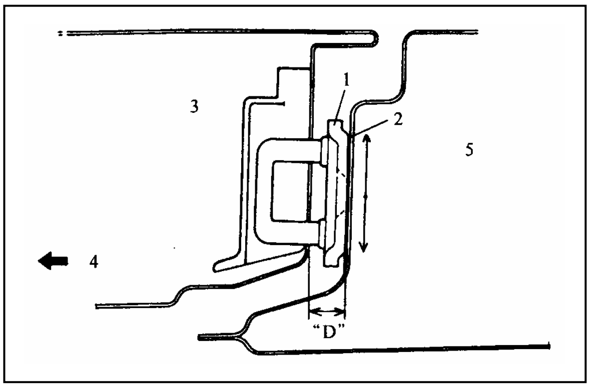


Fig. 19-20

1-Door striker 2-Shims 3-Door 4-Front side 5-Body

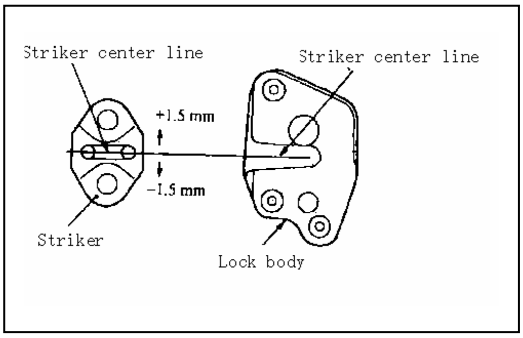


Fig. 19-21

19.11 Door adjusting

1 Front door

- Front door removal sequence

(1) Front fender

(2) Harness connector

(3) Bolt for stopper of the body

(4) Bolts for hinge of the body

(5) Door assy

(6) Support the door assy using a jack with a piece of wood placed between the jack and door assy as shown in Fig. 19-22.

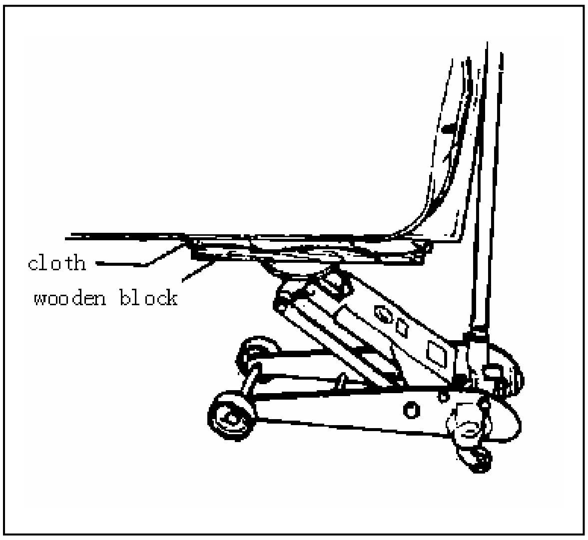


Fig. 19-22

Caution:
Be careful to move or lift.

- **Front door installation**

The installation sequence is reverse to the removal sequence.

- Installation service key points

(1) If the gap between the door and body is inconsistent (>1.5mm), to loosen the fixing bolt of the door hinge at the body side, and moving the door until the gap and step around the door becomes consistent

(2) If the door has vertical sinkage after closed, to adjust the alignment of the striker and latch by increase or decrease the shims. At the same time, to adjust the door by moving the latch in all directions.

2 Slide door

- Installation

(1) When the weatherstrip become hard, water leakage may happen. In this case, replace it if possible.

(2) After installed, adjust the door latch striker position and door.

Front door adjustment is shown as followed:

① Remove slide door stoppers "1" by loosening screws.

② Adjust lower arm "4" so that door front door outer panel "2" and body surface "3" align each other with the door closed as shown in Fig.19-23.

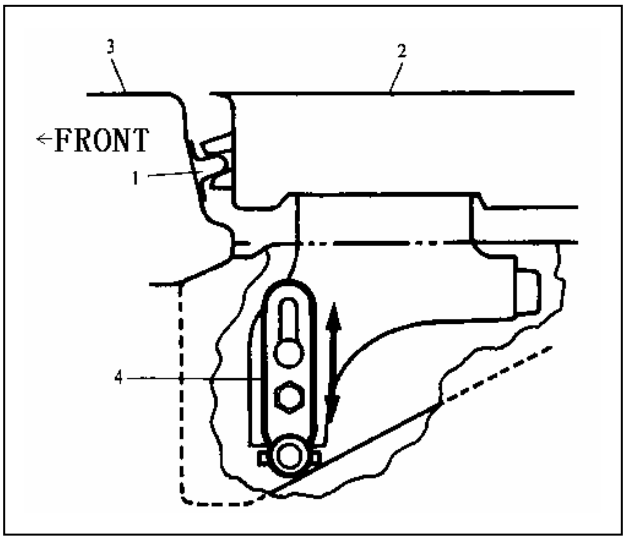


Fig. 19-23

③ Remove door inside handle, inner trim and waterproof film, adjust slide door hinge to make the gap between the door and body surface be equal.

④ Adjust the slide door stoppers and tighten the screws.

3 Tail door

- **Tail door removal sequence**

(1) Rear washer hose
(2) Harness connector
(3) Tail door gas spring
(4) Tail door assy

- **Tail door gas spring removal sequence key points**

(1) After the gas springs are detached, to keep them way from high temperature surrounding or fire.
(2) Before discarding the removed gas spring, Envelop it as illustrated with nylon tape, and then, Drill a hole of 2 to 3 mm in diameter through the tape into the gas spring as shown in Fig. 19-24.

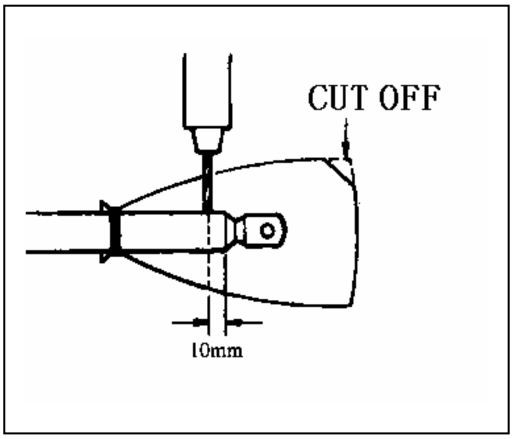


Fig. 19-24

(3) Handle the gas spring with care. Do not scar or scratch the exposed surface of its piston, and never allow any paint or oil to stick on the surface.

Installation and adjustment of tail door

(1) align the striker and latch by moving the striker up and down or outside and inside, see Fig. 19-25. Be sure that the deviation between the center of striker and the latch is within ±1.5mm, see Fig. 19-25.

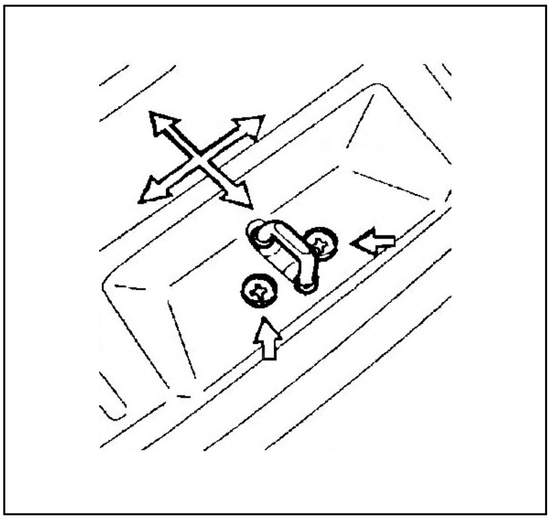


Fig. 19-25

⑵ If the gap between the door and body is inconsistent, to adjust the position of the hinge and striker, see fig 19-25.

● **Removal and installation of the tail door glass**

(1) Removal sequence as shown in Fig. 19-26

①Harness connector ④ Weather strip lower

②Tail door glass ⑤ Upper Weather-strip

③ Dual lock fastener ⑥ Both side Weather-strip **Removal key points**

Removal sequence of the tail door glass is same as removal sequence of windshield.

● Installation

The installation sequence is reverse to the removal sequence.

● Installation service key points

① Clean and degrease the surface of tail door glass where to be applied adhesive and to be attached dual lock fastener.

② Install the weatherstrip according to the following sequence: Both side Weather-strip, Upper weather-strip upper, Lower weather-strip, location and relations installed is shown in Fig. 19-27.

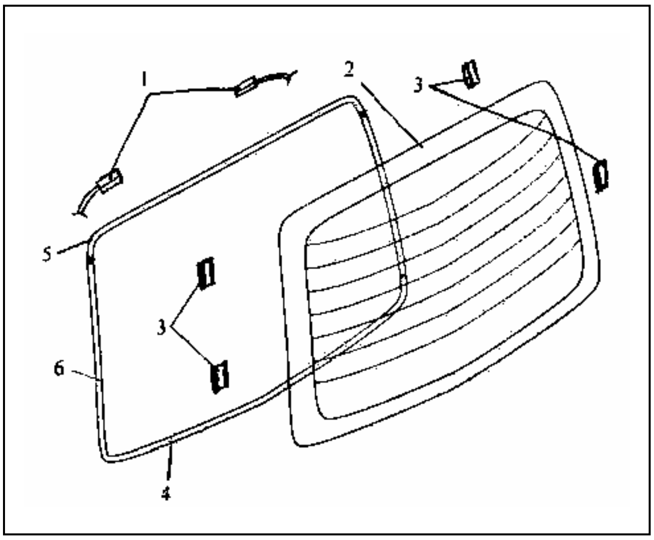


Fig. 19-26

③ Attach the dual lock fastener to the area with protruding mark on the tail door outer panel, see Fig. 19-28.

④ Apply the adhesive to the glass along the center line as Fig. 19-29 shown.

⑤ The rest of operations refer to the installation of windshield.

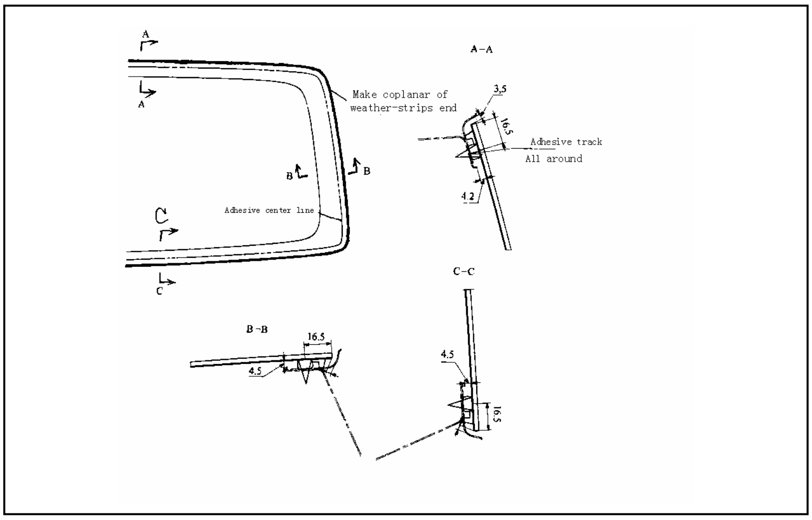


Fig. 19-27

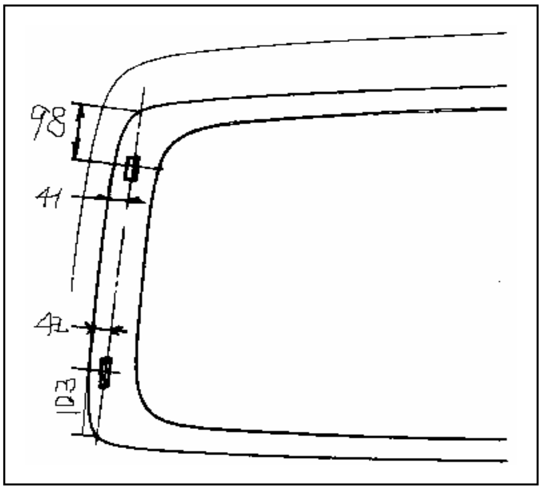


Fig. 19-28

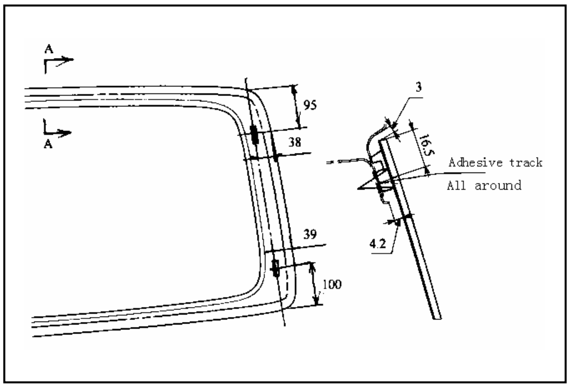


Fig. 19-29

19.12 Installation and removal of bonnet

Removal sequence of bonnet: (see Fig. 19-30)

1. Bonnet latch
2. Bonnet lock cable assy

3. Adjusting rubber buffer
4. Fixing housing
5. Bonnet support beam
6. Clip
7. Bonnet hinge assy LH
8. Bonnet hinge assy RH
9. Glue-block
10. Bonnet

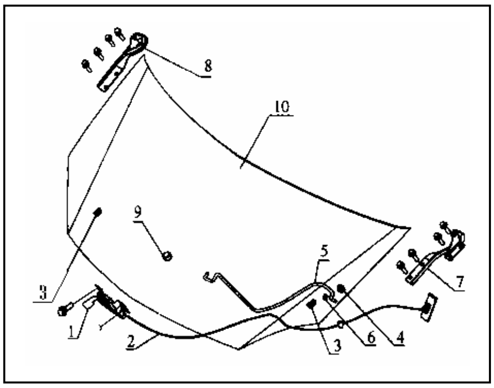
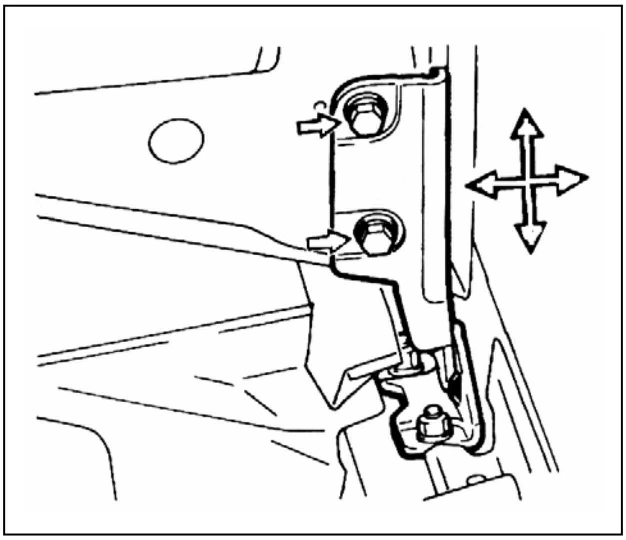


Fig. 19-30

① Adjust the clearance between the bonnet and body all around bonnet as shown in Fig. 19-31

② Adjust the height of bonnet as shown in Fig. 19-32.



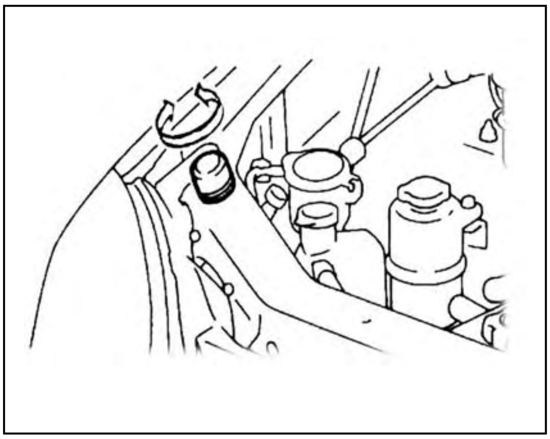


Fig. 19-31 Fig. 19-32

③ Adjust bonnet latch and striker to mesh well as shown in Fig. 19-33

- Bonnet installation

Reverse the removal sequence of installation.

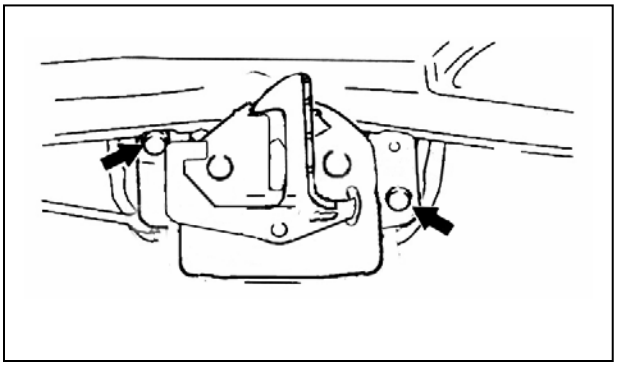


Fig. 19-33

19.13 Installation and removal of wheel splash guard

1 Installation and removal of the front wheel splash guard upper

● Install sequence of front wheel splash guard upper

① Attach rear wheel splash guard firmly to body in its right position;

② Tighten the screw to fix the wheel splash guard firmly according to the arrow direction with clip and tapping screw as shown in Fig. 19-34.

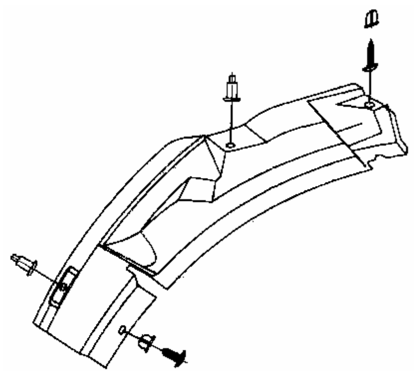


Fig. 19-34

● Removal sequence of front wheel splash guard upper

Reverse the installation sequence to remove the front wheel splash guard.

2 Installation and removal of front wheel rear splash guard

● Install sequence of front wheel rear splash guard

① Attach front wheel rear splash guard firmly to body in its right position;

② Tighten the screw to fix the wheel rear splash guard firmly according to the arrow direction with tapping screw as shown in Fig. 19-35.

● Removal sequence of front wheel rear splash guard

Reverse the install sequence to remove the front wheel rear splash guard.

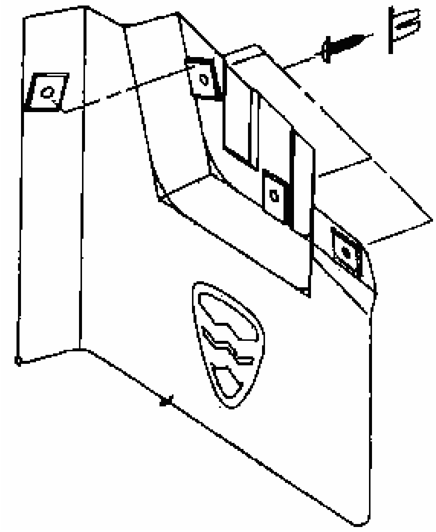


Fig. 19-35

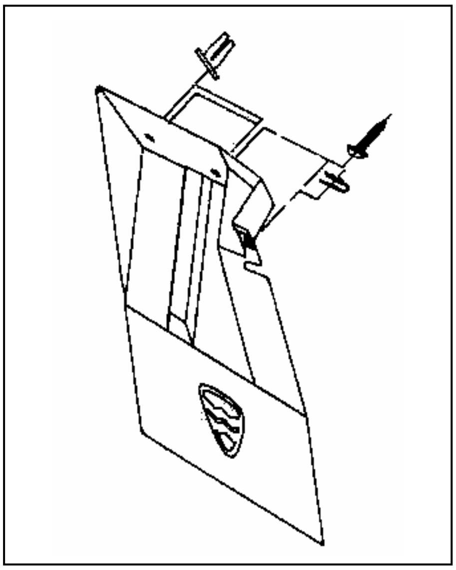


Fig. 19-36

3 Installation and removal of rear wheel splash guard

- Install sequence of rear wheel splash guard

① Attach rear wheel splash guard firmly to body in its right position;

② Tighten the screw to fix rear wheel splash guard firmly according to the arrow direction with tapping screw as shown in Fig. 19-36.

- Removal sequence of rear wheel splash guard

Reverse the install sequence to remove the rear wheel splash guard

19.14 The removal and installation of the front grill

- Removal sequence of the front grill:

① Remove the clip fixed on the body as shown in Fig. 19-37;

② Remove the front grill with plain screw driver from the middle of grill gap to bottom mounting points, prize up gently.

- Installation sequence:

Reverse the removal sequence of installation.

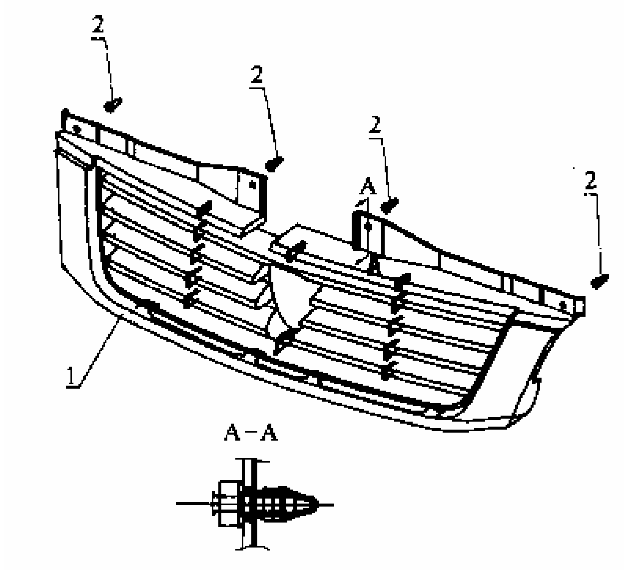


Fig. 19-37

19.15 The removal and installation of front bumper

- **Removal sequence:**

① Remove the screw fixed on the body;

② Remove the screw and plastic pin fixed on the fender panel;

③ Remove the screw fixed on the headlight bracket as shown in Fig. 19-38;

④ Disconnect all kinds of connector of front bumper, remove the front bumper along the horizontal direction.

- **Installation sequence:**

Reverse the removal sequence of installation.

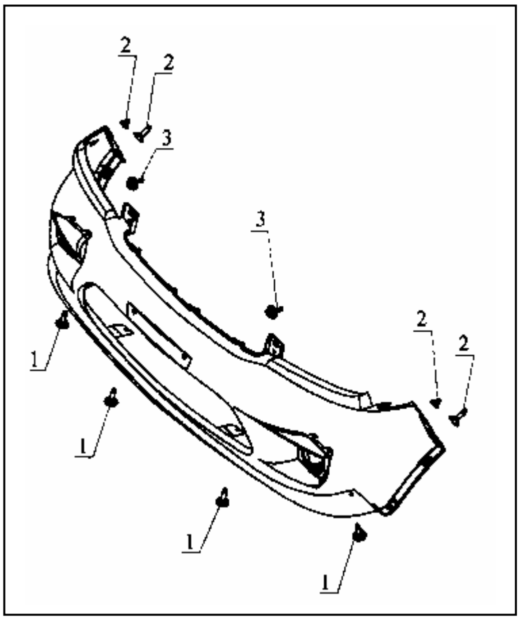


Fig. 19-38

19.16 The removal and installation of rear bumper

- **Removal sequence:**

① Remove plastic pin fixed on the outer side panel.

③ Remove the screw fixed on the body as shown in Fig.19-39

④ Disconnect all kinds of connector of rear bumper, remove the rear bumper along the horizontal direction.

- **Install sequence:**

Reverse the removal sequence of installation.

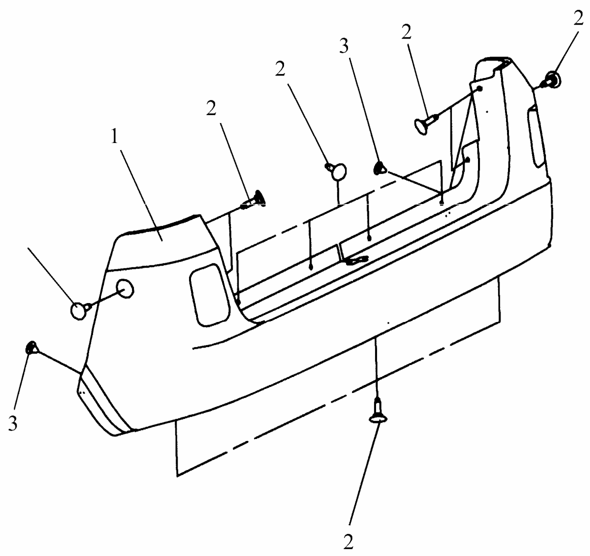


Fig.19-39