1.1 Engine Assembly

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1.1.1 Major parameters and maintenance data of engine

1.1.1.1 Performance parameters of engine

Changan SC1021 series trucks use three kinds of engines i.e.JL465Q5, JL474Q (gasoline engine) and YD480 (diesel engine) . For performance parameters see table 1.1-1.

Table1.1-1

Engine model	JL465Q5	JL474Q	YD480
Engine type	Gasoline engine		Diesel engine
Structure design	In-line, four-cylinder, four -stroke, water cooling , multi-Point Injection		In-line four-cylinder, four -stroke, water cooling , direct Injection
Cylinder number – bore X stroke(mm)	4 - 65×74	4 - 74×76	4 - 80×90
Displacement (ml)	1012	1310	1809
Compression ratio	8.8: 1	9.5: 1	18: 1
Rated power(KW)	39(5300r/min)	60(6000r/min)	29(3300r/min)
Max. torque	78	102	≥104
Min. fuel consumption(g/kw.h)	288	298	248.8
Min. no-load permanent speed (r/min)	850±50	750±50	≤900
Cylinder working order	1-3-4-2		
Lubricating method	Forced and splash lubrication		
Cooling method	Forced-feed water circulation		
Start method	Electric startup		
Intake method	Natural intake		

1.1.2 Major structure of engine

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1.1.2.1 Gasoline engine

(1) Cylinder head

The main function of cylinder head is to seal the upper part of cylinder and to form a combustion chamber with piston top and cylinder. The so called "nose section" between intake valve and exhaust valve as well as between intake valve , exhaust valve and spark plug of gasoline engine has a very high thermal stress, and is a place where cracks easily occur. The structure of cylinder head of gasoline engine of JL465 and JL474 is as shown in Figure 1.1-1.

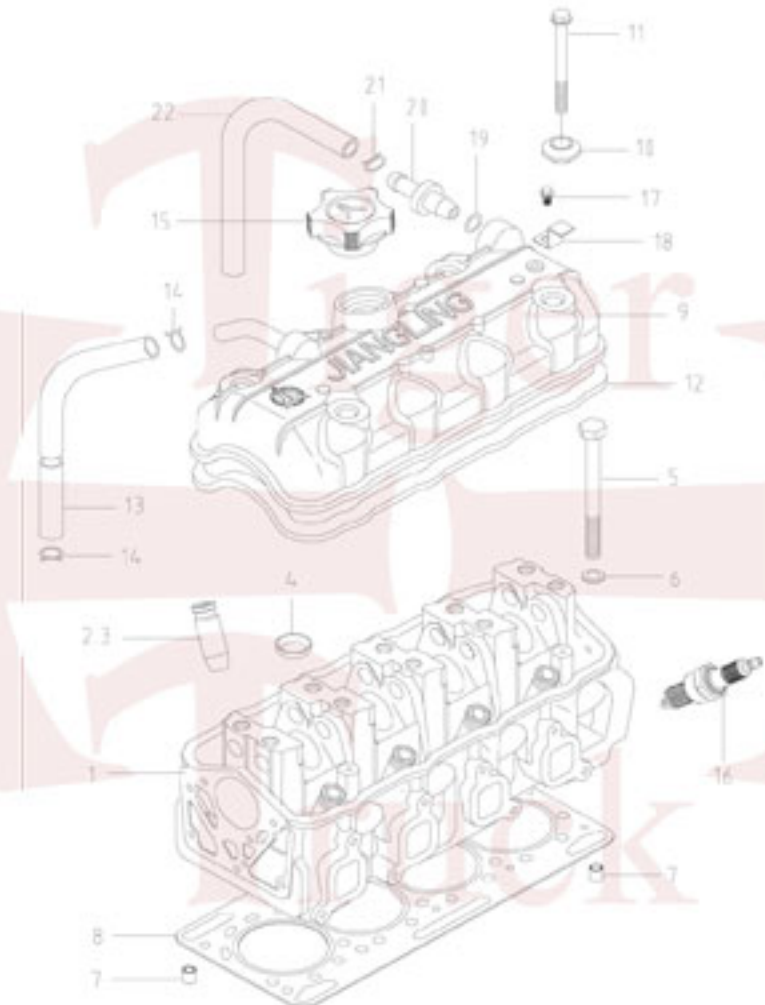


Fig.1.1-1: Cylinder head

1. cylinder head; 2. intake valve guide tube; 3. exhaust valve guide tube; 4. bowl-shaped plugΦ20; 5.cylinder head stud; 6.wahserΦ10; 7. Cylinder head dowel pin; 8.cylinder head gasket assembly; 9. Cylinder head cover assembly; 10. Cylinder head cover bolts and washers assembly; 11.cylinder head bolts; 12. Cylinder head cover gasket; 13.bleeding pipe; 14. Bleeding pipe clamp; 15.filler cap assembly. 16. Spark plug assembly; 17. Cross recess head screws; 18. Stand; 19. sealing ring; 20; PVC valve; 21. Bleeding valve clip; 22. PVC valve connecting pipe.

(2) Cylinder block

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Engines of JL465 and JL474 use in-line multi-cylinder engine block, which is simple in structure and can be easily manufactured. For structure schematic drawing see Fig. 1-2.

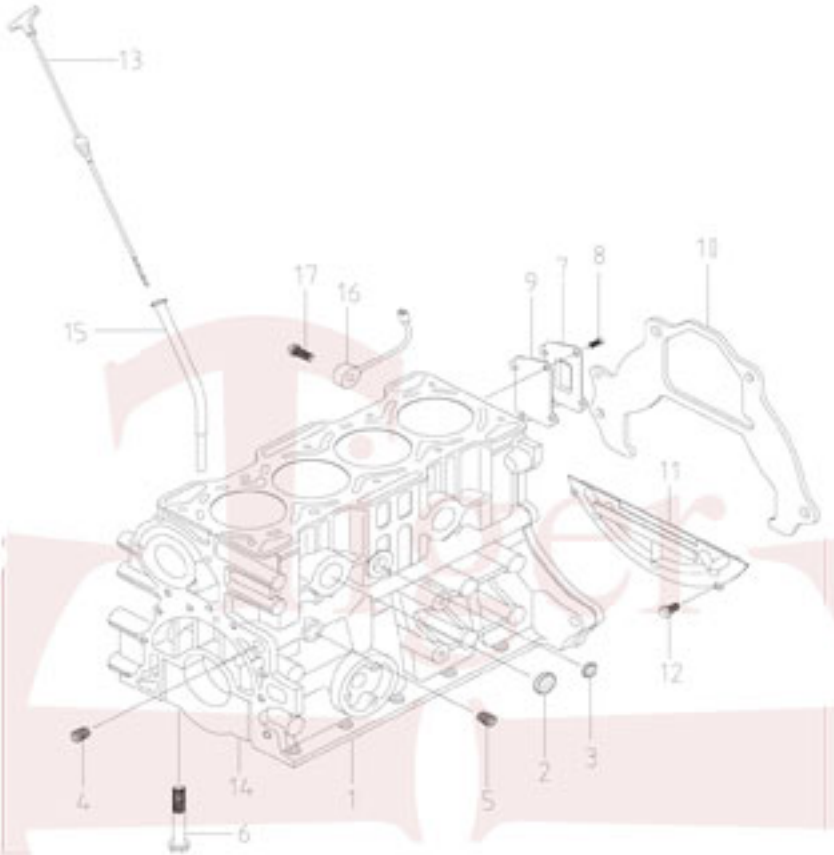


Fig.1.1-2: cylinder block

1. Crankcase assembly; 2. bowel plugΦ30; 3.bowel plug Φ20; 4. Tapered plug screw Z1/4; 5.tapered plug screw Z1/8; 6.crankcase main bearing cap bolts; 7. Water sealing cover; 8. Bolts/gaskets; 9. Water-sealing cover gasket; 10.diaphragm; 11. Baffle assembly; 12. Bolts/washers; 13. Oil level gauge assembly; 14. first crankcase main bearing cap, second crankcase main bearing cap, third crankcase main bearing cap, fourth main bearing cap, fifth crankcase main bearing cap; 15. Oil level gauge guide tube; 16. Knock sensor; 17.hex. Flange bolts.

(3) Oil pan

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The main function of oil pan is to keep oil and seal crankcase. Generally, it is made of steel sheet by pressing. See Fig. 1.1-3 for oil pan of JL465 and JL474 engines.

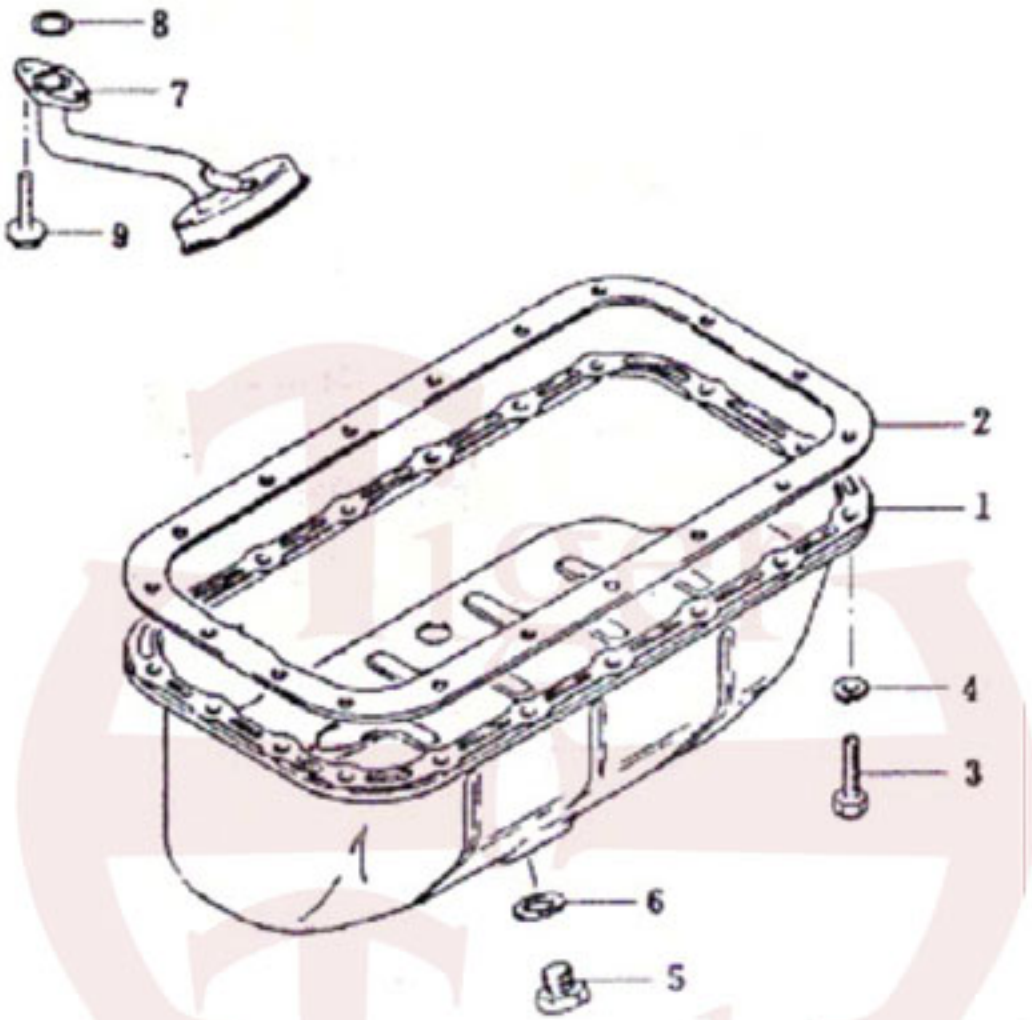


Fig.1.1-3: oil pan

1. Oil pan assembly; 2. Oil pan gasket; 3. Bolts; 4. Washer; 5. Drain plug; 6. Gasket; 7. Oil filter assembly; 8. Pipe connection O-ring; 9. Bolts/washer.

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(4) Crankshaft link mechanism

See Fig.1.1-4 for crankshaft link mechanism of JL465 and JL474 engines.

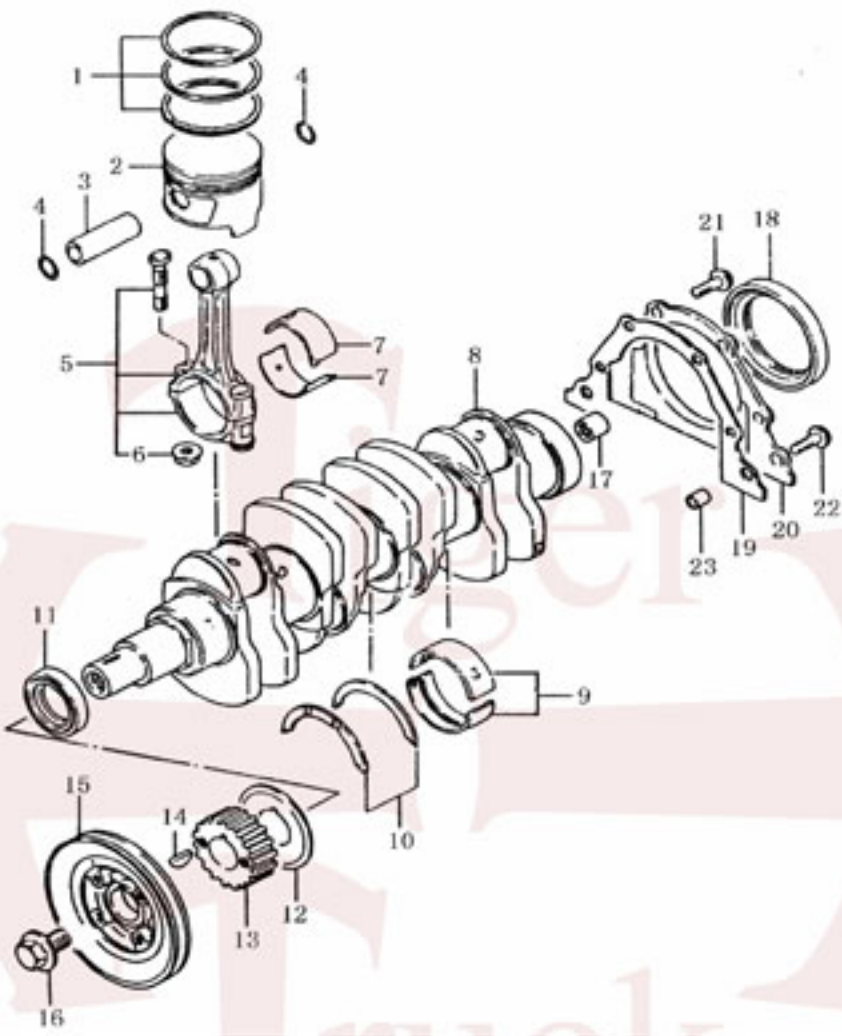


Fig.1.1-4: crankshaft link mechanism

1. Piston ring assembly; 2. Piston; 3. Piston pin; 4. Circlip; 5.connecting rod assembly; 6. Connecting rod bolts; 7. Connecting rod bearing; 8. Crankshaft; 9. Main bearing; 10. Crankshaft thrust plate; 11.crankshaft front oil seal assembly; 12. Diaphragm baffle; 13. Crank timing belt pulley; 14. Woodruff key5×19; 15. Driving V- belt pulley; 16.bolts/washer; 17. Rolling bearing; 18. Crankshaft rear oil seal assembly; 19. Crankshaft rear cover; 21. Bolt/washer; 23. Dowel pin.

(5) Valve train

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The function of valve train is to timely open and close intake valve and exhaust valve according to operating cycle and engine firing order requirement of each cylinder to timely let fresh air flow into cylinder(Methanol-Gasoline Blend for gasoline car; air for diesel car) , and to exhaust emission from cylinder.

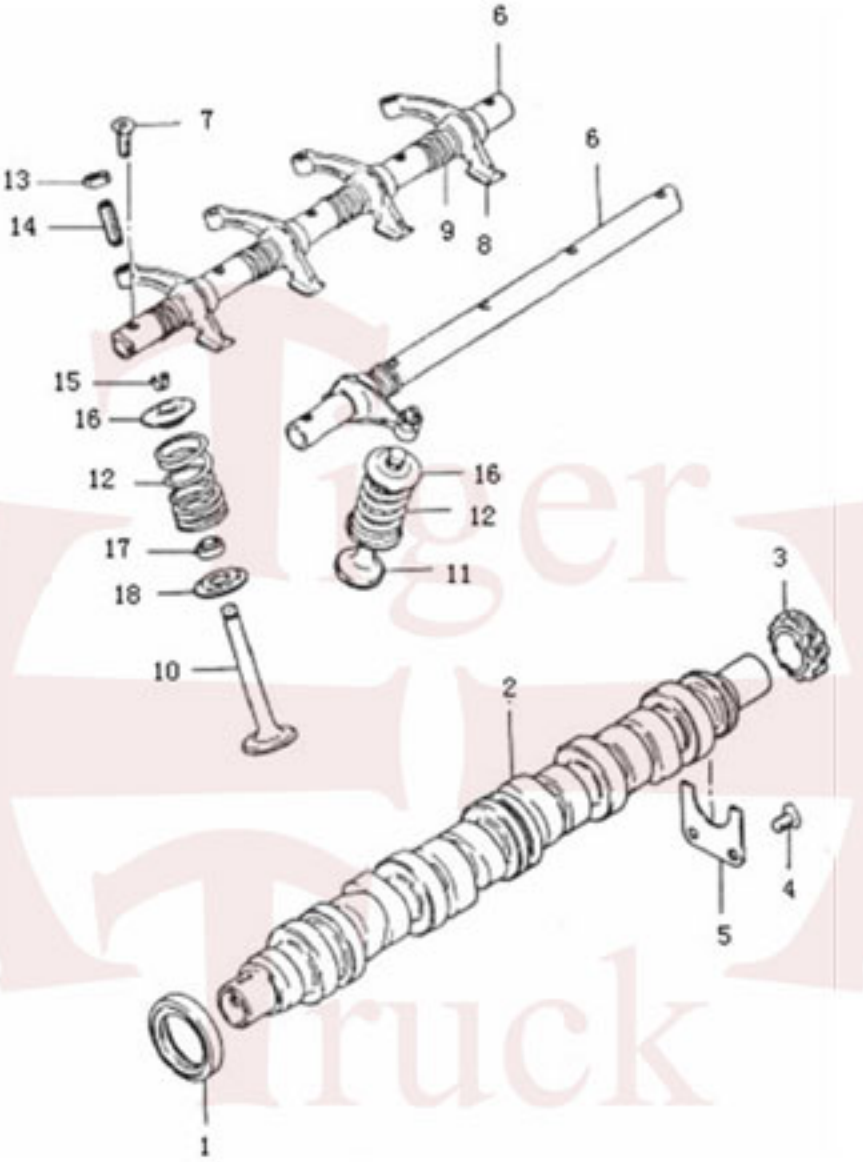


Fig.1.1-5 valve train

1. Camshaft oil seal assembly; 2. Camshaft; 3. Helical toothed wheel; 4. Screw; 5. Camshaft thrust plate; 6. Rocket shaft; 7. Screw; 8. Rocker; 9. Rocket spring; 10. Intake valve; 11. Exhaust valve; 12. Valve spring; 13. Valve rocker shaft adjusting nut; 14. Rocker adjusting screw; 15. Valve conical cotter. 16. Valve spring retainer; 17. Valve oil seal assembly; 18. Valve spring seat.

(6) Timing mechanism

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To improve air intake and exhaust conditions by extending the time for air intake and exhaust to improve engine power performance. See Figure 1.1-6 for the construction.

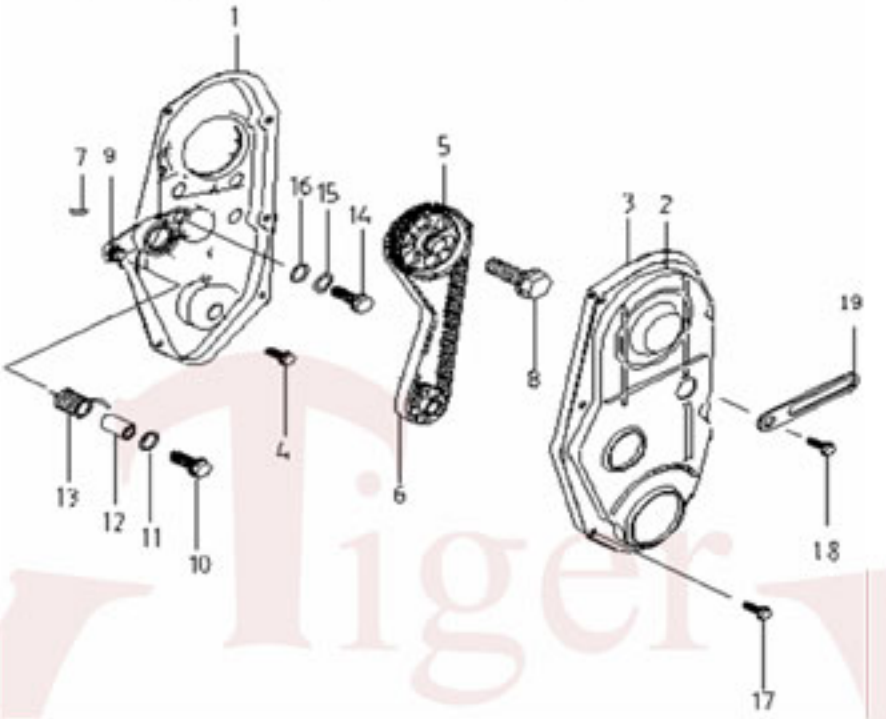


Fig.1.1-6 Timing mechanism

1. Timing belt rear cover assembly; 2. Timely belt front cover assembly; 3. Rubber gasket of front and rear cover housing; 4; bolt/washer; 5. Camshaft timing belt pulley; 6. Timing belt; 5. Woodruff key; 8. Bolt; 9. Tension gear. 10. Bolt; 11. Helical torsion spring; 12. Helical torsion spring washer; 12. Helical torsion spring bushing; 13. Torsion spring; 14. Bolt; 15. Washer; 16. Alternator support washer; 17. Bolt/washer; 18. Bolt/washer; 19. Long supporting piece.

(7) Intake manifold

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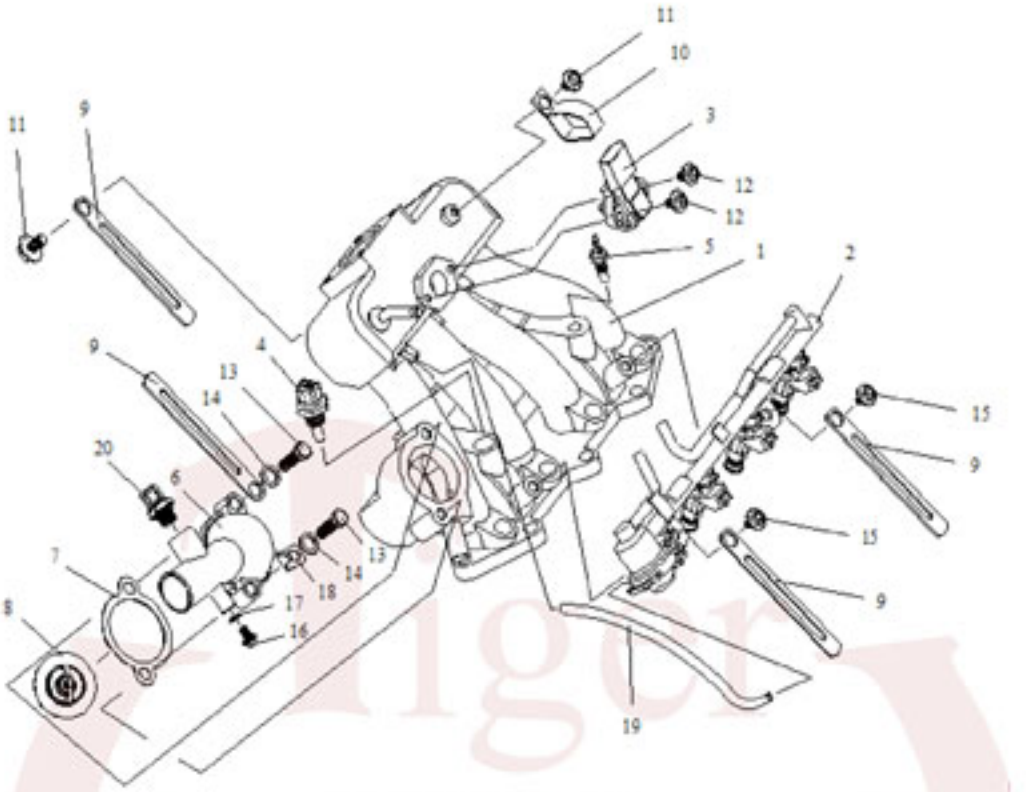


Fig.1.1-7 Intake manifold

1. Intake manifold subassembly; 2. Fuel manifold assembly. 3. Intake air pressure temperature sensor assembly; 4. Water temperature sensor assembly; 5. Water temperature sensor assembly; 6. Temperature adjuster cover; 7. Temperature adjuster cover sealing gasket; 8. Temperature adjuster assembly; 9 long supporting piece; 10; locking pipe bracket; 11. Bolt; 12. Bolt. 13. Bolt. 14. Gasket; 15. Bolt; 16. Cooling system bleed screw; 17. Cooling system bleed screw gasket; 18. Earth tag; 19. Pressure regulator vacuum hose; 20. Cooling fan switch assembly.

(8) Induction system

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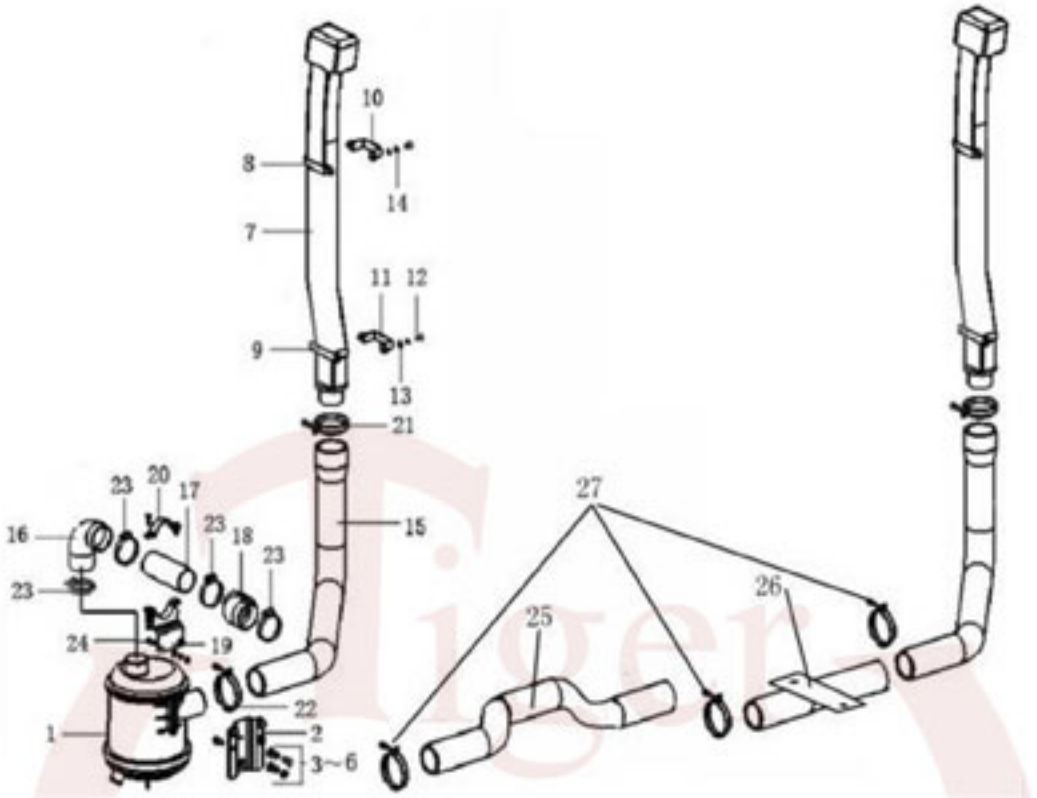


Fig.1.1-8 Induction system

1. Air filter assembly; 2. Air filter bracket assembly; 3. Nut M8; 4. Bolt M8×16-4.8; 5. Gasket 8; 6. Gasket 8; 7.intake port; 8.intake port bracket 1; 9. Intake port bracket 2; 10. Intake port clamp; 11.intake ort clamp; 12. Bolt M6×16-4.8; 13.washer 6; 14. Washer 6; 15. Air intake pipe 1; 16. Air intake pipe; 17. Air intake pipe 3; 18. Air intake pipe 4; 19. Air intake pipe clamp bracket; 20. Air intake pipe clamp cover; 21. Double-wire hoop 70; 22.double-wire hoop 64; 23.fastener; 24.bolt M6×16-4.8; 25. Air cleaner inlet pipe; 26.intermediate inlet pipe assembly, boltM6×16-4.8, washer 6, washer 6; 27.double-wire hoop 64.

(9) Intake manifold ramp plate

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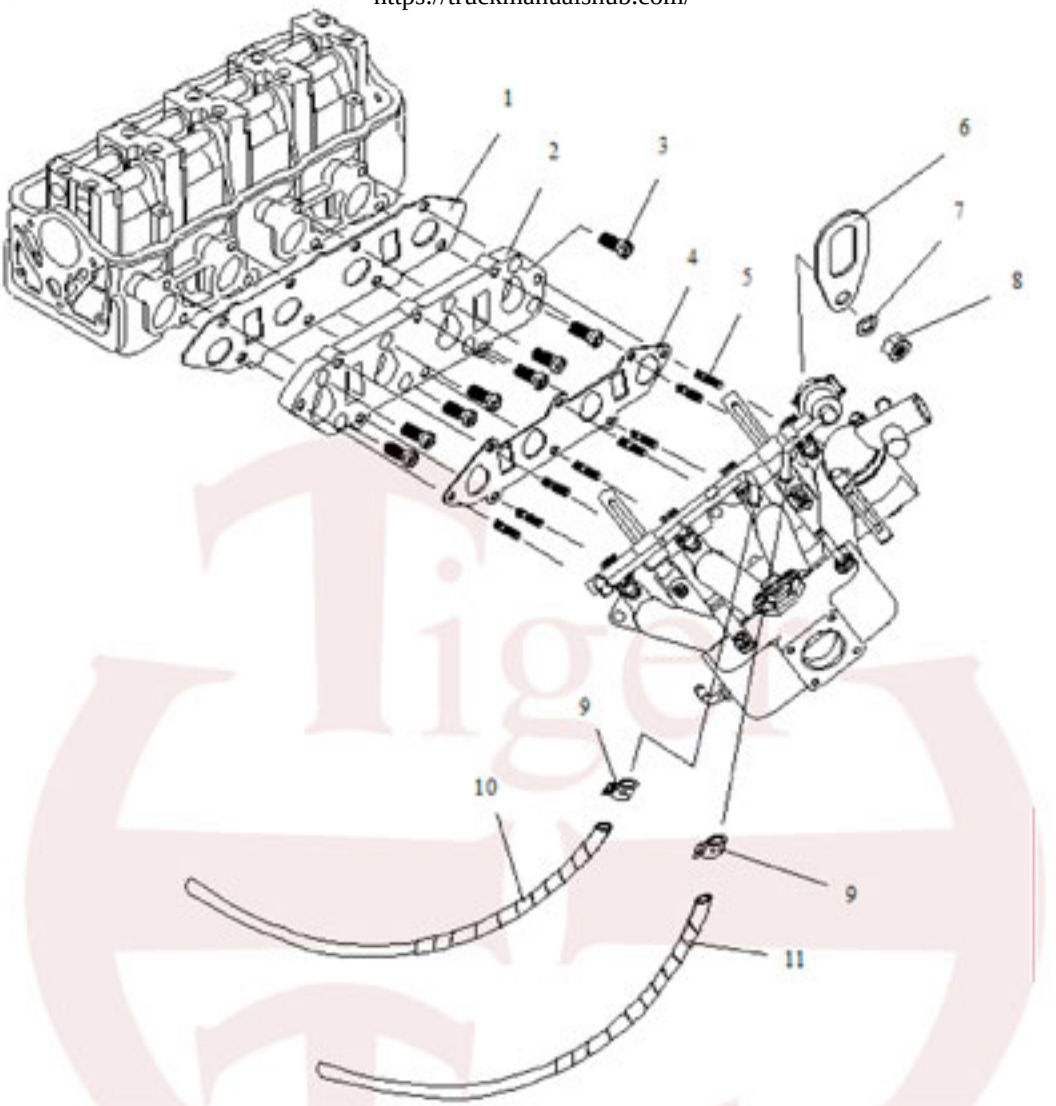


Fig.1.1-9 Intake manifold ramp plate

1. Cylinder head ramp plate paper gasket; 2. Intake manifold ramp plate; 3. Bolt; 4. Ramp plate and intake manifold gasket; 5. Stud; 6. Hook; 7. Washer; 8.bolt; 9. High pressure oil pipe clamping band; 10. Fuel intake pipe assembly; 11. Fuel returns pipe assembly.

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(10) Silencer

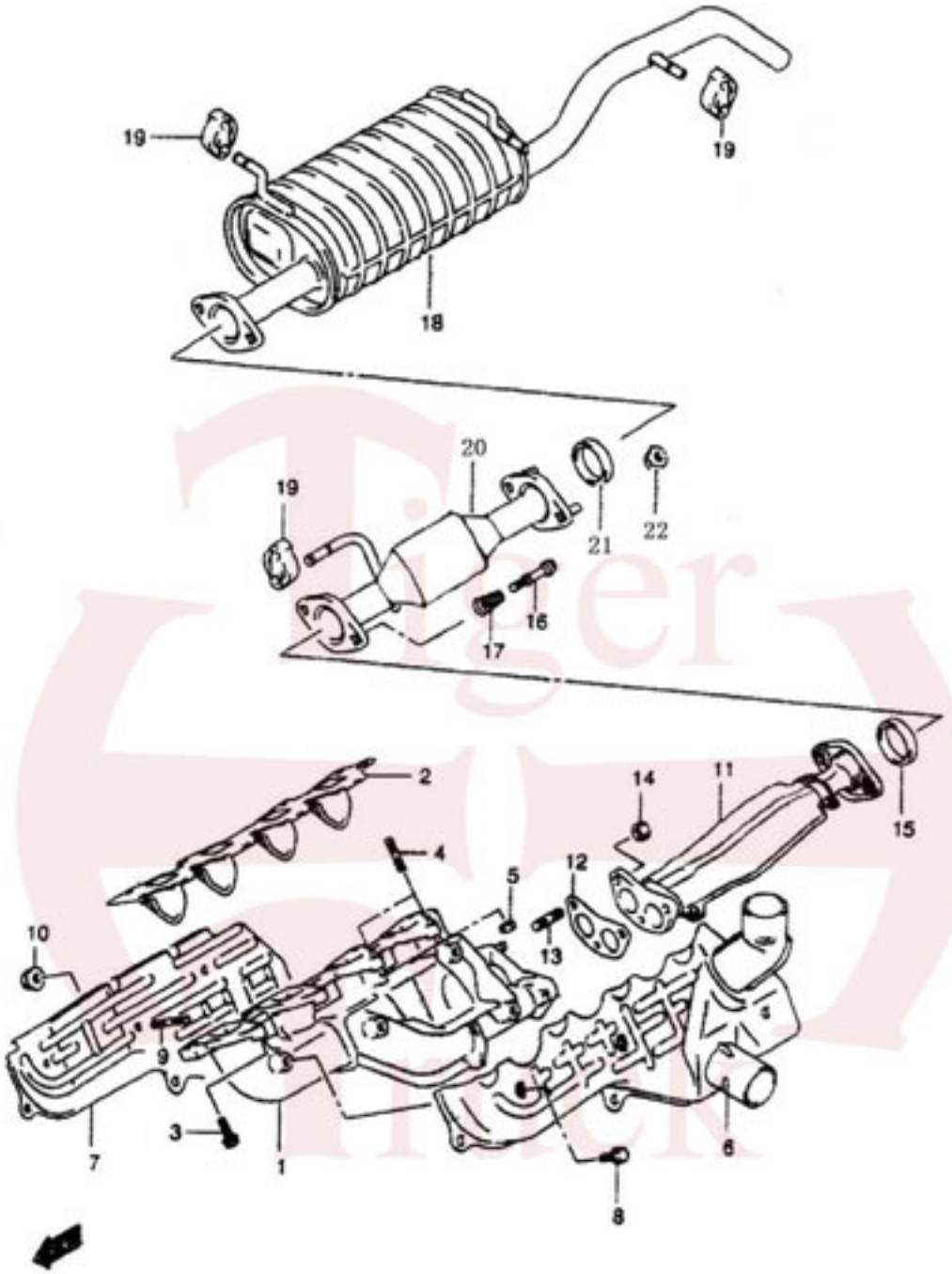


Fig.1.1-10 Silencer

1. Exhaust manifold; 2. Exhaust manifold gasket assembly; 3. Bolt; 4. Stud; 5.bolt; 6. Exhaust manifold hood assembly; 7. Exhaust manifold lower hood assembly; 8. Bolt; 9.stud; 10. Nut; 11. Exhaust pipe; 12. Exhaust pipe gasket; 13. Stud; 14. Nut; 15. Silencer flange gasket; 16. Silencer flange bolt; 17. Exhaust pipe spring; 18. Welded silencer assembly; 19. Connecting rubber gasket; 20. Three-element catalytic converter; 21. Exhaust pipe gasket; 22. Nut M10×1.25-8.

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(11) Fuel pump

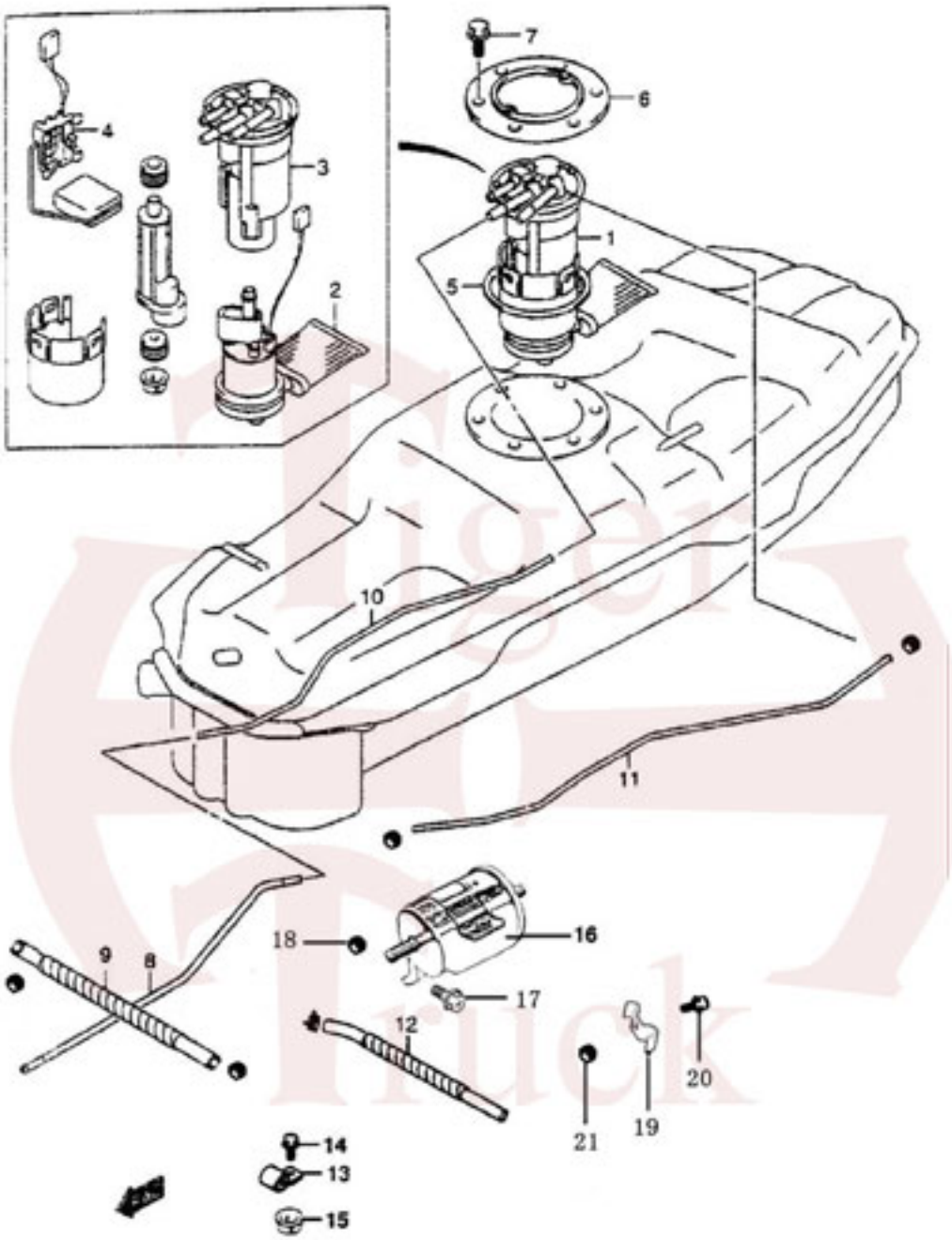


Fig.1.1-11 fuel pump

1. Fuel pump and sensor assembly; 2. Gasoline filter; 3. Fuel pump body; 4. Fuel level sensor assembly; 5.fuel pump gasket; 6. Fuel pump flange; 7. Bolt M6×12-4.8; 8. Fuel return connecting pipe; 9. Electronic spray fuel return rubber pipe I; 11.electronic spray fuel feed rubber pipe I; 12. Electronic spray fuel feed rubber pipe II; 13. Lock pipe bracket; 14. bolt M6×16-4.8; 15.nut M6-5; 16.gasoline filter; 17.bolt M8×20-4.8; 18.nut M8-5; 19.double pipe clip; 20.bolt M6×16-4.8; 21.nut M6-5.

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(12) Oil pump

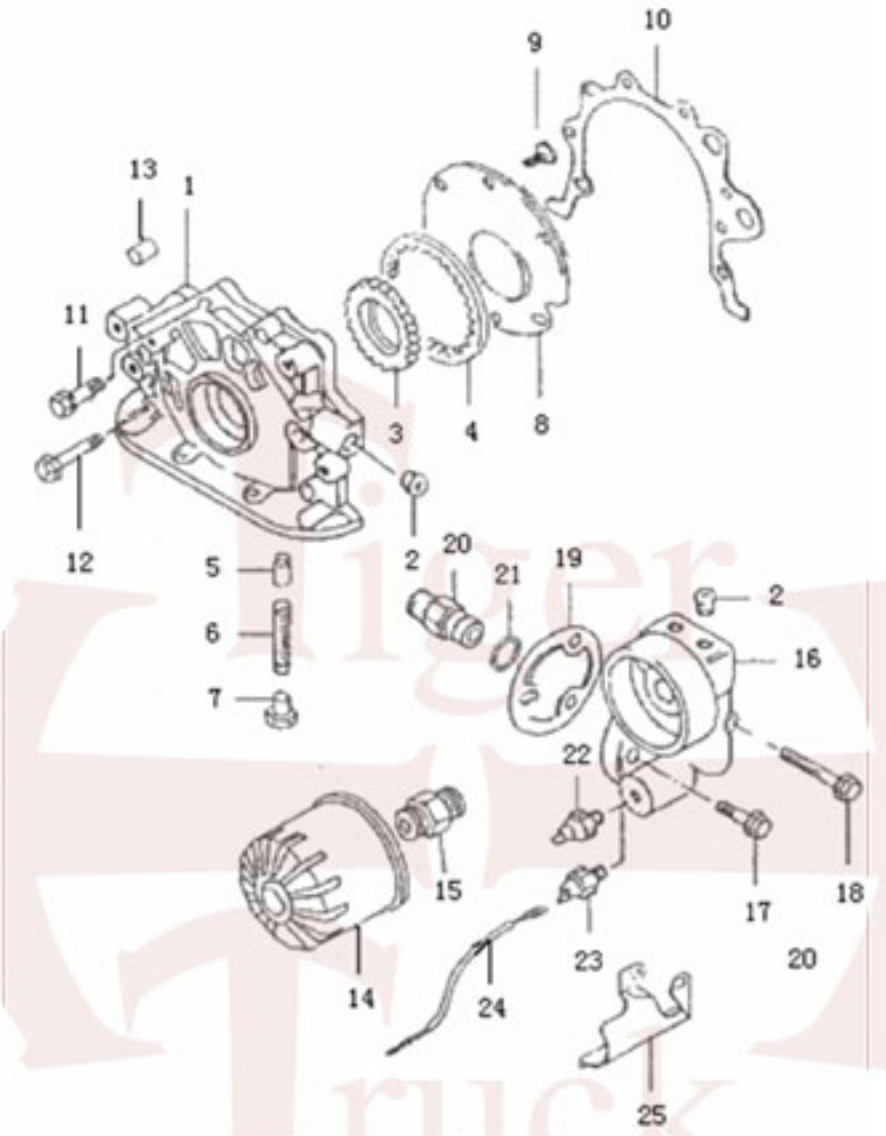


Fig.1.1-12 Oil Pump

1. Oil pump assembly; 2 tapered screw plug; 3. Gear; 4 annulus; 5. Pressure-limiting valve; 6. Pressure-reducing valve spring; 7.pressure-reducing valve screw plug; 8. Pump cover; 9. Screw; 10. Oil pump gasket; 11. Bolt/gasket; 12. Bolt/gasket; 13. Dowel sleeve; 14. Oil filter assembly; 15. Connecting pipe; 16. Oil filter bracket; 17. Bolt/gasket; 18. Bolt/gasket; 19. Oil filter bracket gasket; 20. Oil filter bracket connector tube; 21.adaptor union O-ring; 22, 23: oil pressure alarm; 25. Oil pressure alarm harness assembly; 25. Oil pressure alarm hood.

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(13) Radiator

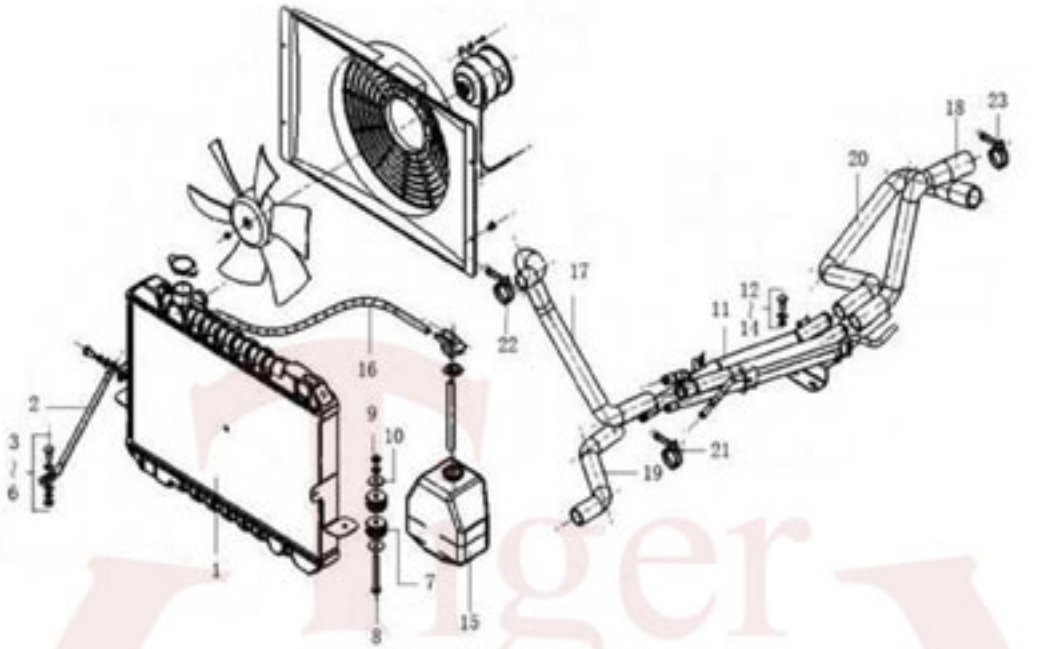


Fig.1.1-13 radiator and water tank with floor water pipe assembly

1. Radiator; 2. Radiator stay; 3. bolt M8×20-4.8; 4.nut M8-5; 5.washer 8; 6.washer 8; 7.rubber gasket; 8.bolt M8×65-4.8; 9.nut M8-5; 10.washer 8; 11. Floor water pipe assembly; 12.boltM6×12-4.8; 13 .washer 6; 14. Washer 6; 15. Battery assembly; 16. Rubber hose; 17.upper hose (front) ; 18. Upper hose (rear) ; 19.lower hose (front) ; 20.lower hose (rear) ; 21. Double-wire hoopΦ32; 22. Double-wire hoopΦ35; 23.double-wire hoopΦ38.

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1.1.2.2 Diesel engine

(1) Alternator and actuating motor assembly

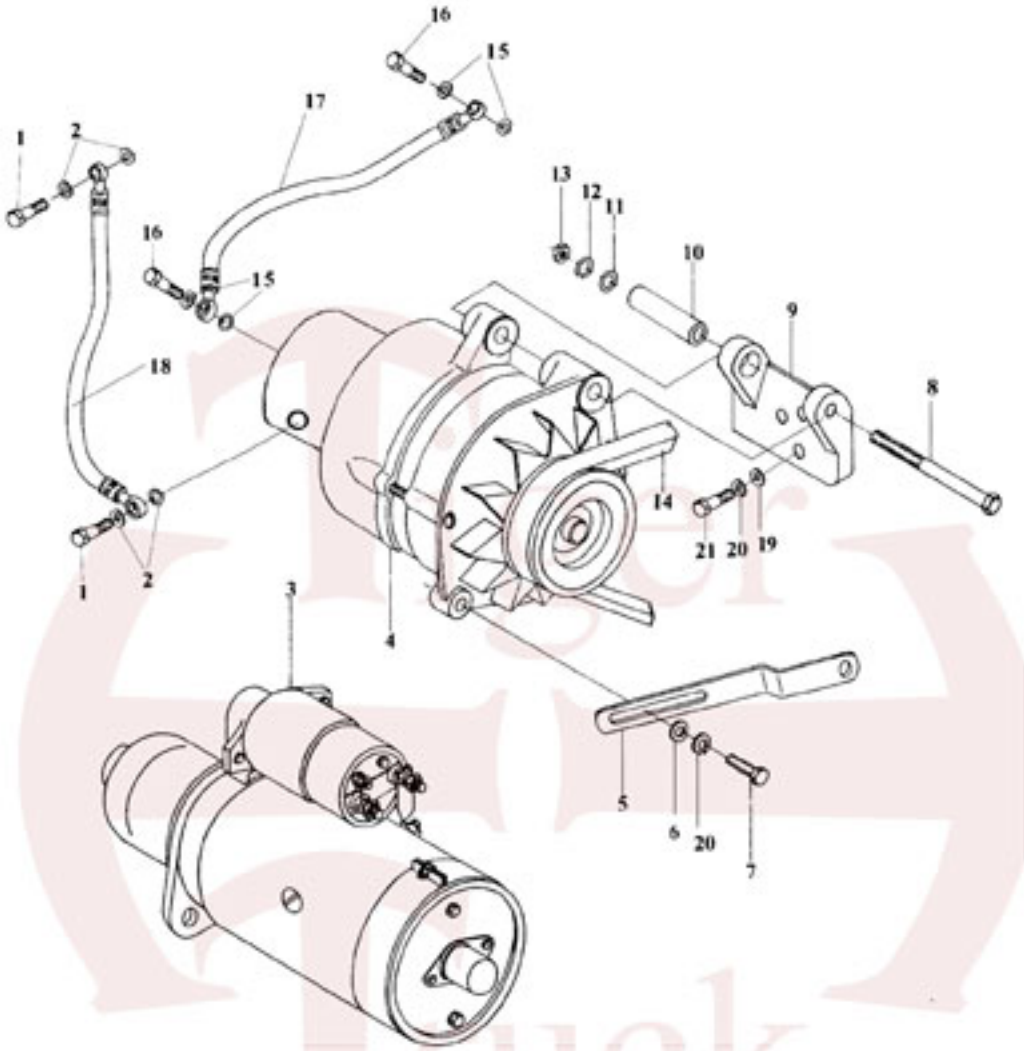


Fig.1.1-14 alternator and actuating motor assembly

1.hinged bolt; 2.gasket; 3.actuating motor part; 4.JFWZB15Y type vacuum pump generator; 5.generator upper support; 6.washer; 7.bolt M8×25; 8.bolt M10×120; 9.generator lower bracket;10.bushing 10-140HV; 11.gasket 10-140HV;12.gasket 10; 13.nut M10;14.auto V-belt A13×965; 15.gasket 10; 16.hallow bolt; 17. Oil inlet pipe part; 18.oil return pipe part; 19.gasket 8-140HV; 10.gasket 8; 21.bolt M8×18.

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(2) Piston and connecting rod assembly

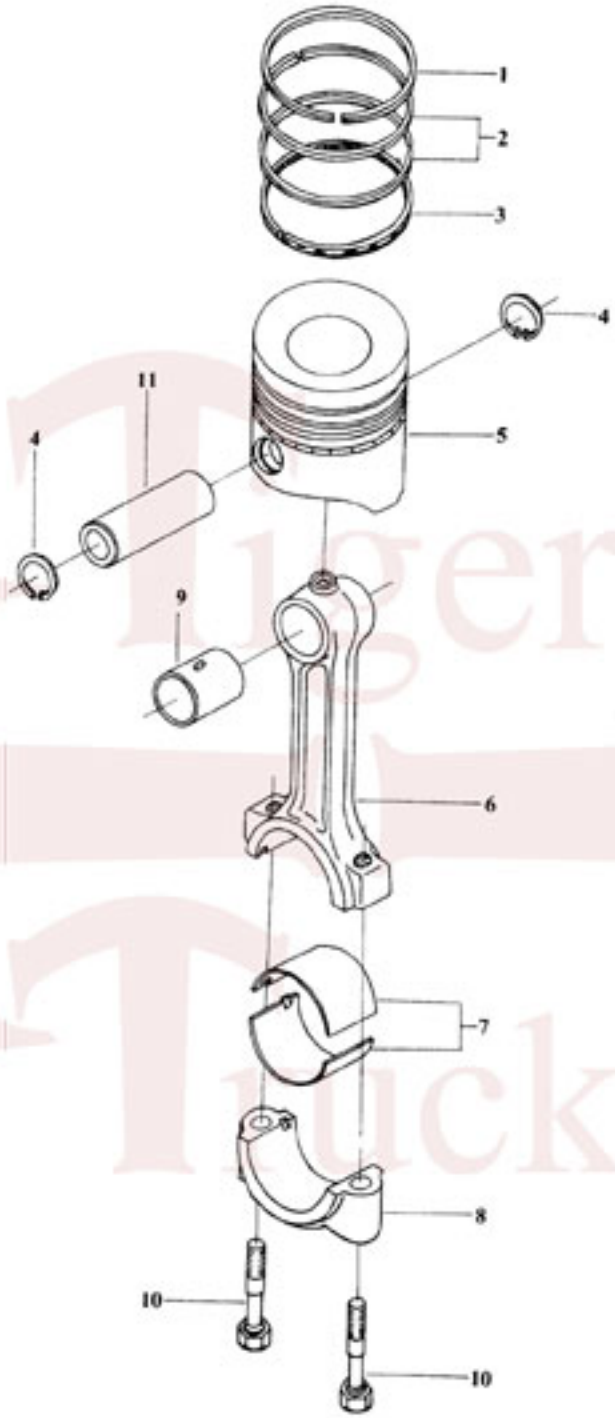


Fig.1.1-14 piston and connecting rod assembly

1. Top piston ring; 2. Second and third piston ring; 3.oil control ring part; 4. Elastic circlip 28; 5. Piston; 6.connecting rod; 7 connecting rod bearing; 8.connecting rod cap; 9. Connecting rod bush; 10. Connecting rod bolt; 11.piston.

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(3) Engine body assembly

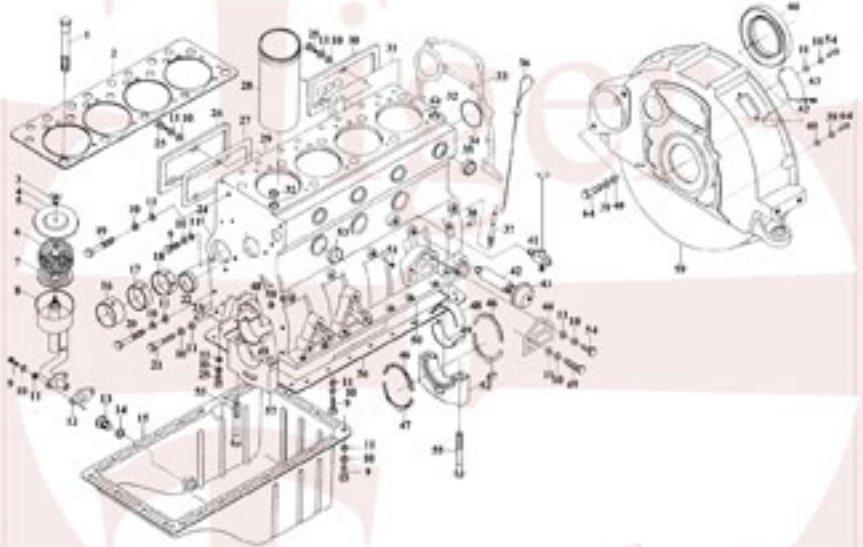


Fig. 1.1-15 engine body assembly

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1. Cylinder head bolt; 2. Cylinder head gasket; 3. Butterfly nut M6; 4. Gasket 6-140HV; 5.breather cap; 6.strainer; 7.breather spacer; 8.breather welded part; 9. Bolt M8×20; 10.gasket 8; 11.gasket8-140HV; 12. Breather gasket; 13. drain plug; 14.gaset; 15.oil sump; 16.canshaft front bushing; 17.camshaft middle bushing; 18.camshaft rear bushing; 19.bolt M8×70;20. bolt M8×65;21.bolt M8×55;22.piston like bowel(φ44) ;; 23.pin B8×20;24.plug;25.bolt M8×25;26.side cover (□) ; 27.side cover (□) ;28.cylinder sleeve; 29.engine body; 30.side cover (□) ;31.side cover (□) gasket;32.dowel bushing; 33.flywheel housing gasket; 34.patch; 35.bowl like patch;(φ25) ;36.oil dipstick part; 37.oil level gauge tube welded part;38.pin B10×20;39.washer 10; 40.washer10-140HV;41.water drain cock; 42.oil pressure sensor adaptor; 43. low oil pressure alarm; 44.oil filter gasket; 45.bolt M8×50;46.camshaft thrust plate(upper) ; 47.camshaft thrust plate(lower) ;48.main bearing – upper bearing; 49. Main bearing – lower bearing; 50. plug; 51.plug(II) ; 52.rear main bearing cover; 53.bowl like patch(φ32) ;54.bolt M8×30;55.main bearing cover bolt; 56. Oil sump gasket; 57.maing bearing cover; 58.plug (I) ; 59. flywheel housing; 60.framework rubber oil seal PG80×100×12;61.screw M6×12;62.washer 6-140HV;63.closing panel; 64. Bolt M10×30.

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(4) Intake manifold assembly

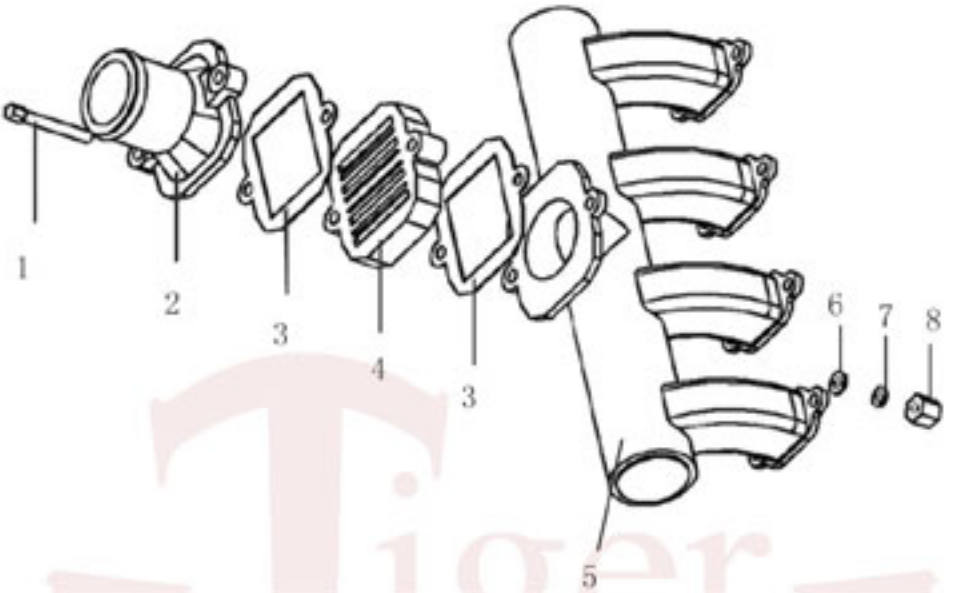


Fig.1.1-16 Intake manifold assembly

1. Bolt M8×60; 2.air intake adaptor; 3.air intake elbow; 4.electric heater part; 5.main pipe; 6.gasket 8; 7.gasket 8; 8.nut M8.

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(5) Cooling system assembly

Cooling system is of pump circulation cooling liquid type. Its main parts are water pump, water tank, temperature regulator and water filter etc.

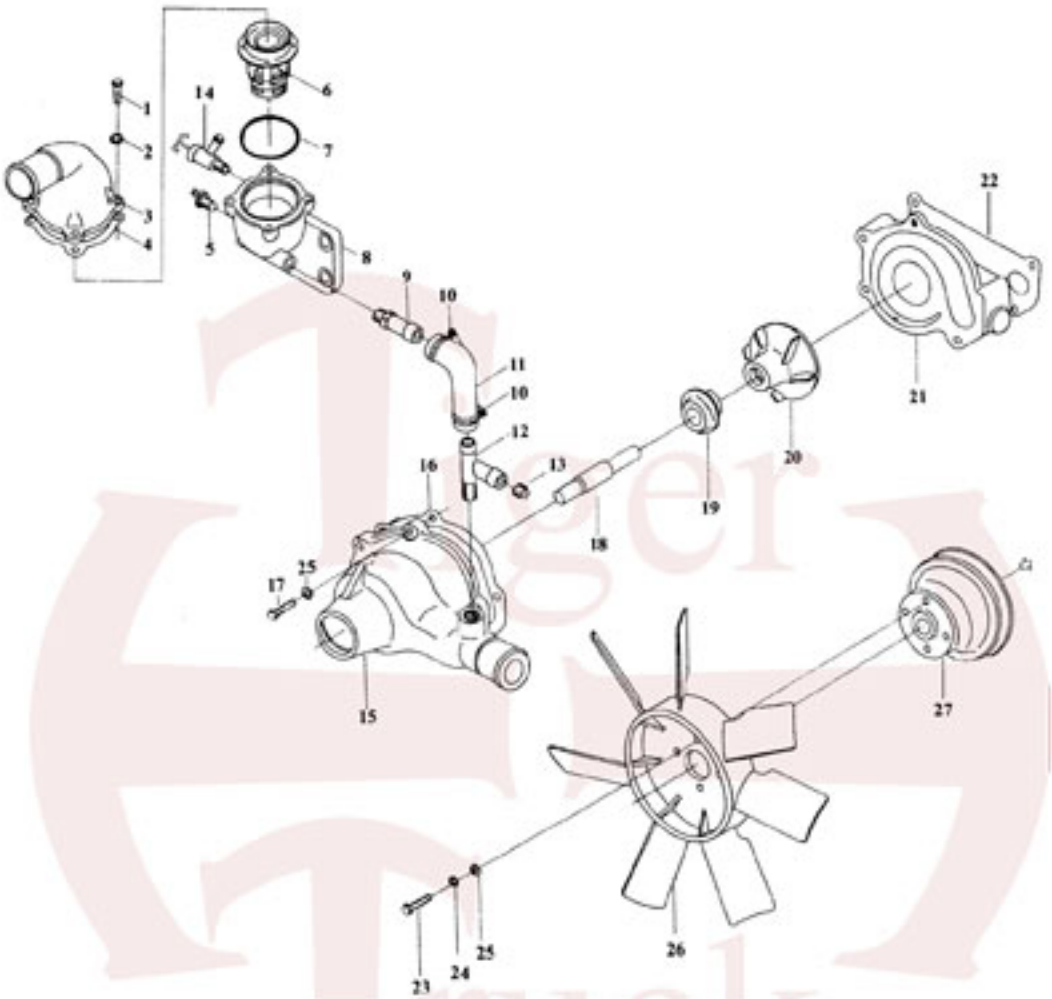


Fig.1.1-17 cooling system assembly

1.bolt M6×20;2.gasket 6-140HV;3.thermostat; 4.thermostat cover gasket; 5.water temperature sensor; 6.SH130 thermostat; 7.thermostat washer; 8.thermostat case; 9.small circulation adaptor; 10.double-wire hoop Φ26;11.rubber elbow; 12. Tee; 13. NPT1/8 conical screw plug; 14. heater switch assembly; 15.water pump body;16.water pump gasket; 17.bolt M8×30;18.bearing; 18.ceramic graphite water seal; 20.impeller; 21.water pump rear cover; 22.water pump gasket; 23. Bolt M8×20; 24.gasket 8; 25.gasket 8-140HV; 26 fan part; 27. Water pump belt pulley.

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(6) Exhaust manifold assembly

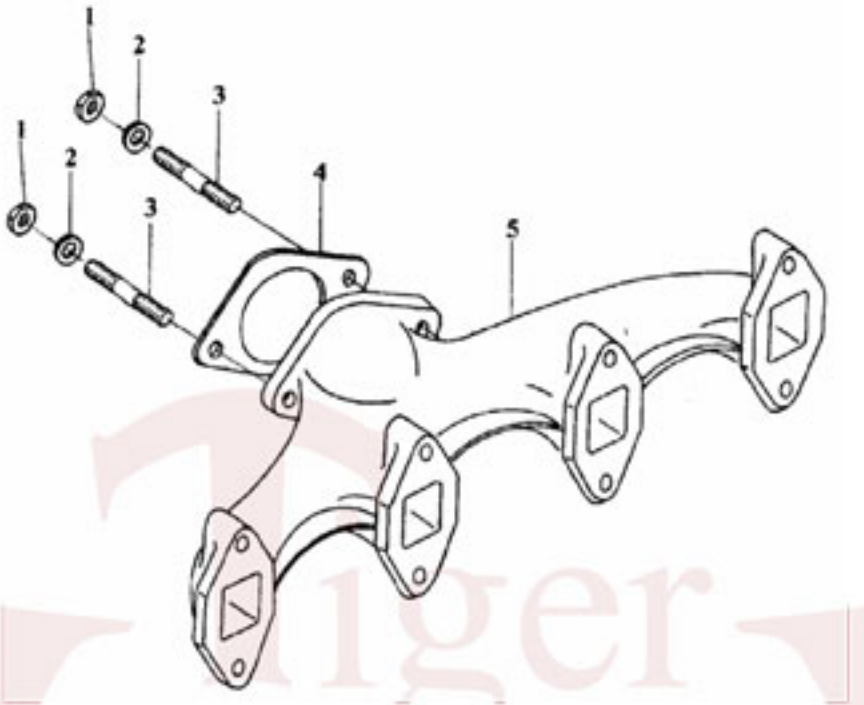


Fig.1.1-18 Exhaust manifold assembly

1. Copper nut; 2. Gasket 10; 3.stud; 4. Exhaust main gasket; 5. Exhaust manifold

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(7) Cylinder head assembly

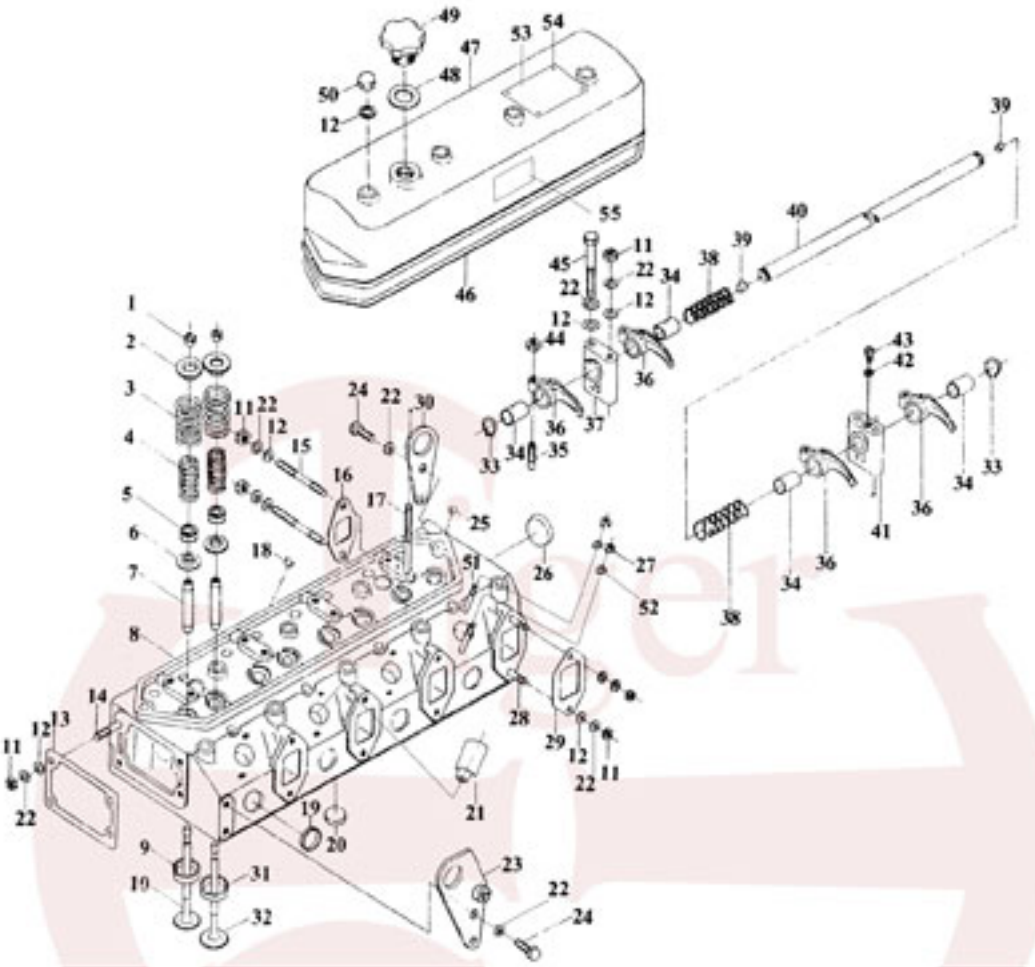


Fig. 1.1-19 cylinder head assembly

1. Valve lock; 2. Valve spring upper seat; 3. Valve exterior spring; 4.valve interior spring; 5.valve stem oil seal; 6. Valve spring lower seat; 7. Valve guide tube; 8. Cylinder head; 9. Exhaust valve seat; 10. Exhaust valve; 11. Bolt M8; 12. Gasket 8-140HV; 13.thermostat case gasket; 14. stud M8×25;15.stud M8×30;16.exhuast pipe gasket; 17.rocker seat locking bolt; 18.plug (φ10) ;19.bowl like patch(φ25) ;20.bowl like patch(φ20) ;21. Oil sprayer bushing; 22.gasket 8; 23. front hoisting hanger part; 24.bolt M8×20;25.plug; 26.bowl like patch(φ44) ;27.nut; 28. Stud; 29. Air inlet pipe gasket; 30. Rear hoisting hanger; 31.intake valve seat; 32. Intake valve; 33.throwing ring 16; 34. Rocker bushing; 35.valve clearance adjusting screw; 36.valve rocker; 37.rocker shaft bracket; 38.rocker shaft spring; 39. Rocker shaft plug; 40. rocker shaft;41.rocker shaft rear bracket; 42;gasket 6-140HV;43.rocker shaft dowel screw; 44.nut M8×1;45.bolt M8×55;46.cylinder head cover gasket; 47.cylinder head cover gasket; 48. Filler cap gasket; 49.filler cap; 50.cap nut M8; 51.stud; 52. Gasket 6; 53.nameplate; 54.rivet; 55. Environment protection mark.

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(8) Crankshaft flywheel assembly

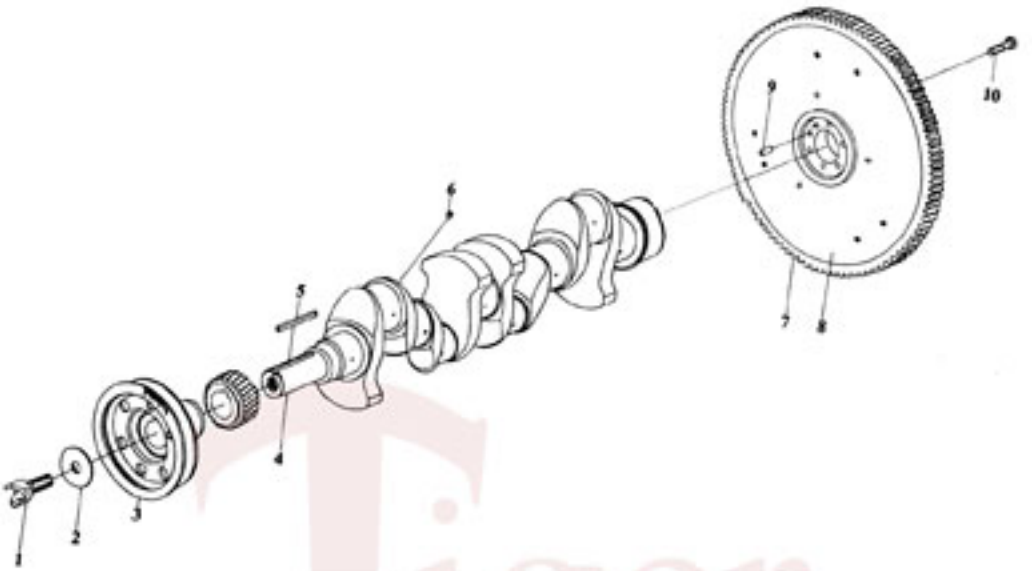


Fig. 1.1-20 crankshaft flywheel assembly

1. Starting jaw; 2.starting jaw base; 3.crankshaft belt pulley; 4.crankshaft; 5. Key C10×64; 7.flywheel tooth ring; 8.flywheel; 9.pin B8×20; 10.flywheel bolt.

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(9) Fuel system assembly

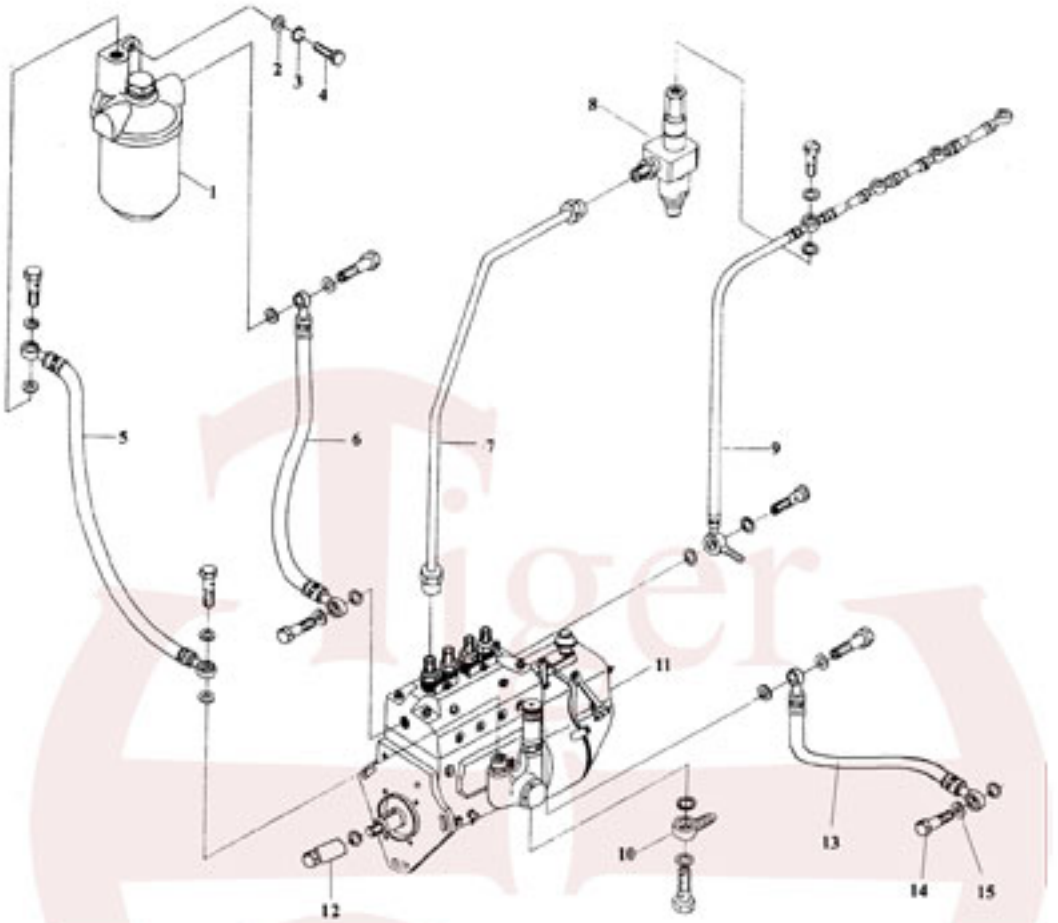


Fig.1.1-21 Fuel system assembly

1. Fuel filter assembly; 2. Gasket 8-140HV; 3.gasket 8. 4. Bolt M8×25; 5.oil pipe parts from fuel injection pump to filter; 6. Oil pipe parts from filter to fuel injection pump; 7.high pressure oil pipe parts; 8. Fuel injection part; fuel return pipe part; 10. fuel injection pump adaptor; 11.fuel injection pump assembly; 12.fuel injection pump camshaft rear end nut; 13.lubricating oil inlet pipe part of fuel injection pump; 14.hallow bolt; 15.gasket 10.

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(10) Lubrication system assembly

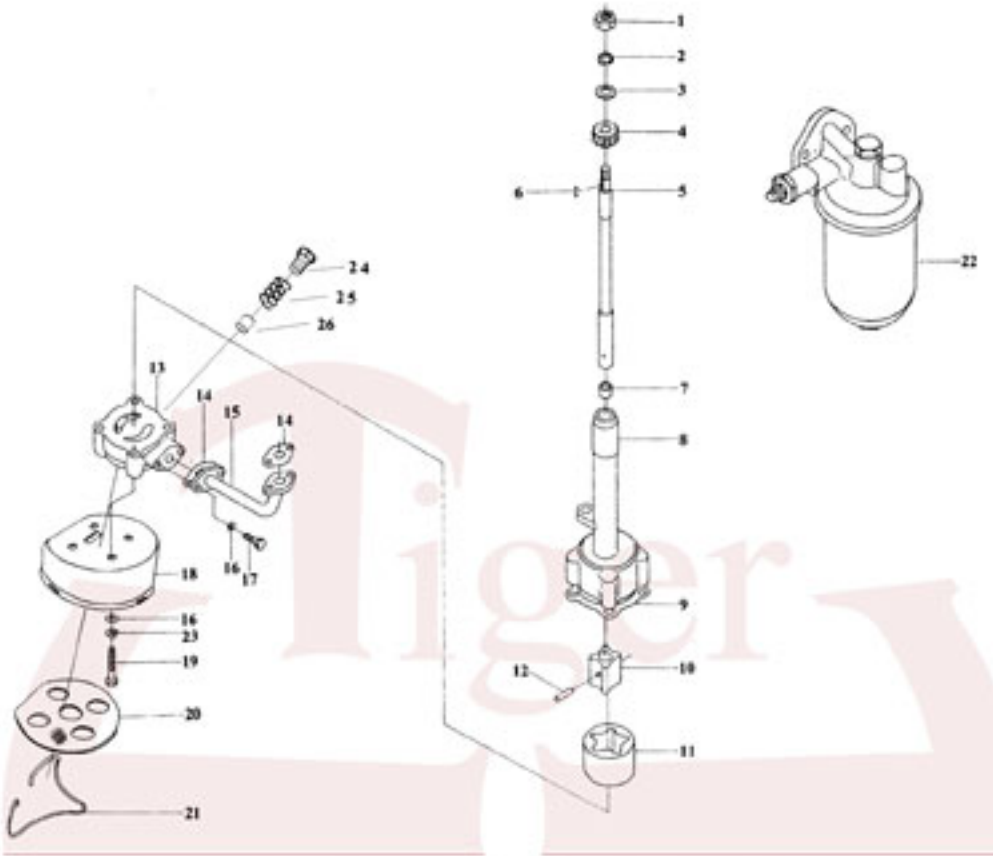


Fig.1.1-21 Lubrication system assembly

1. Nut M10; 2. washer 10-140HV;3.washer 10; 4.oil pump driving gear; 5.oil pump shaft; 6; woodruff key 3×5×13;7.oil pump body bushing; 8.oil pump body; 9.oil pump gasket; 10.inner rotor; 11. outer rotor;12.cylindrical pin;13.oil pump cover; 14.oil outlet pipe flange gasket; 15.oil pipe part; 16.gasket 8-140HV;17.bolt M8×25;18.sieve; 19.bolt M8×40;20.sieve welded part; 21.sieve support; 22.oil filter assembly; 23.gasket 8; 24.screw plug; 25.pressure limiting valve spring; 26.valve

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(11) Camshaft assembly

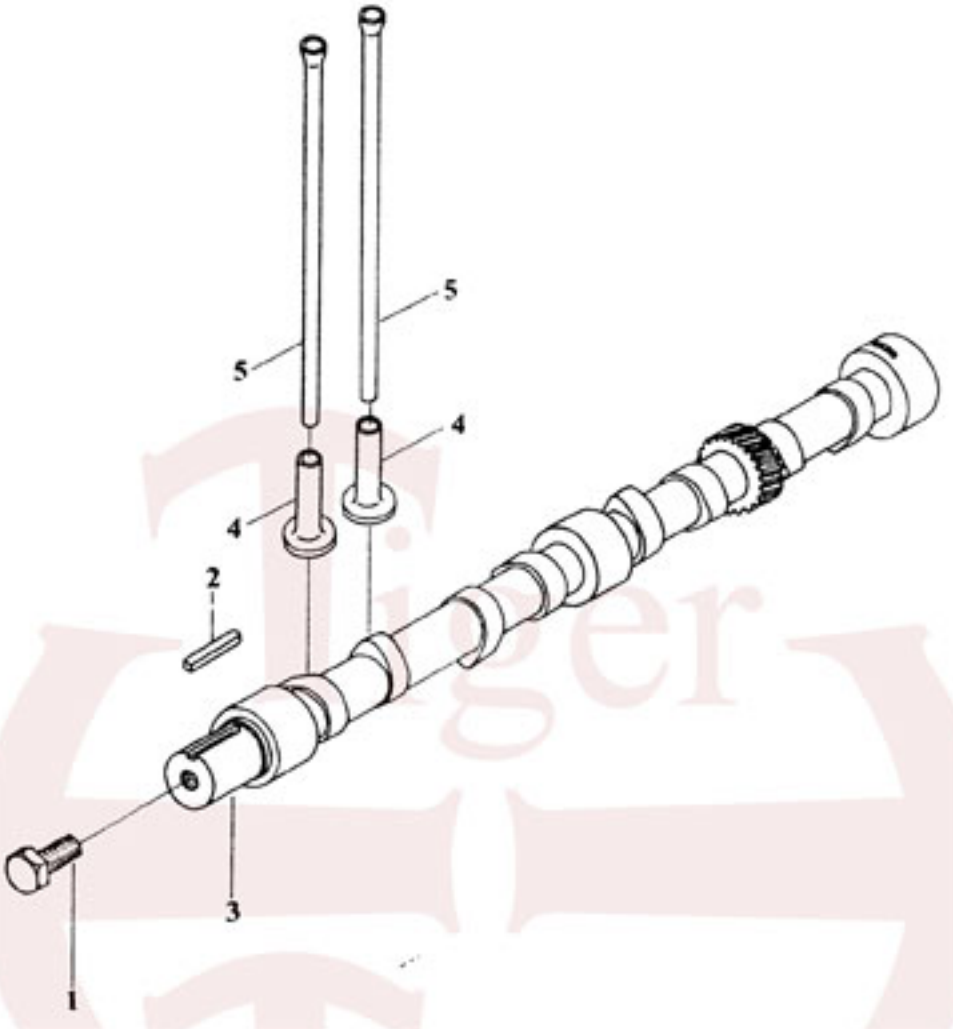


Fig.1.1-22 camshaft assembly

1. Bolt M12×35; 2.key C8×22; 3.camshaft; 4.tappet; 5.push bar

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(12) Timing gear chamber assembly

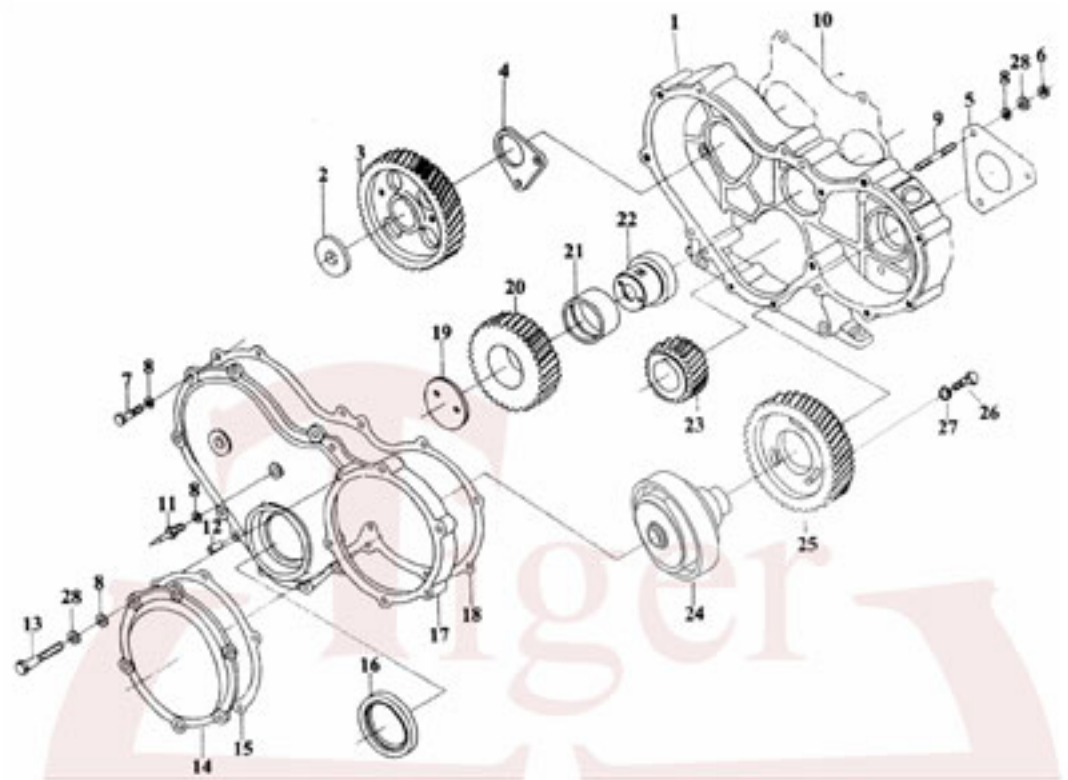


Fig.1.1-23 Timing gear chamber assembly

1- Timing gear chamber 2-camshaft timing gear gland plate; 3-camshaft timing gear; 4-camshaft thrust plate; 5-fuel injection pump gasket; 6-nut M8; 7-bolt M8×20; 8-gasket 8-140HV; 9-stud M8×30; 10- Timing gear chamber gasket; 11-pointer; 12- pin B8×20; 13-bolt M8×35; 14- Timing gear chamber front cover; 15- Timing gear chamber front cover gasket; 16- oil seal SG55×75×12; 17- Timing gear chamber cover; 18- Timing gear chamber gasket; 19-idle gear gland plate; 20- timing idle gear; 21- timing idle gear bushing; 22- timing idle gear shaft; 23-camshaft timing gear; 24- QWNP built-in advance part; 25- fuel injection pump timing gear; 26- bolt M6x16; 27- gasket 6; 28- gasket 8;

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1.1.3 Engine maintenance

1.1.3.1 Disassembling engine

(1) Drain fuel.

(2) Dismount front row seats, then dismount engine compartment central structural member together with gear-shifting control and parking brake lever, and unplug signal harness plug of parking brake lever.

(3) Unplug fog light and light assembly harness plug, and dismount light assembly and bumper assembly.

(4) Dismount positive and negative harness of battery, and canister control valve harness plug, and canister rubber pipe.

(5) Drain coolant and transmission oil.

(6) Dismount engine harness clip from car body and intake manifold.

(7) Dismount cooling fan switch and vacuum solenoid valve as well as vacuum rubber pipe.

(8) Dismount inlet and outlet rubber pipe of expansion tank, and heater water inlet and outlet pulling wire. Dismount radiator water inlet and outlet rubber pipe and heater water inlet and outlet rubber pipe from floor water pipe assembly.

(9) Dismount radiator assembly.

(10) Drain braking liquid and brake flexible pipe between cab and chassis and rubber pipe of brake vacuum booster pump, as well as fixing clip.

(11) Dismount steering stem pipe and separate it from steering gear.

(12) Separate chassis harness from car body harness, dismount ECU harness (gasoline) , dismount ignition coil and harness (gasoline) from cab floor make sure that all harness fixing clips are removed to completely separate chassis harness from car body.

(13) Dismount clutch, acceleration cable and speedometer flexible shaft.

(14) Dismount air cleaner and intake port connecting rubber pipe.

(15) Recheck to make sure that all piping and cables are removed from chassis and cab.

(16) Dismount cab fixing bolts and take them away from cab.

(17) Dismount battery negative wire from air intake manifold.

(18) Dismount fuel cut solenoid valve (diesel) or ECT sensor (water temperature sensor) leading wire (gasoline) .

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(19) Dismount vacuum solenoid valve leading wire (gasoline car) .

(20) Dismount generator leading wire and output terminal.

(21) Dismount air intake flexible pipe.

(22) Dismount fuel inlet pipe and fuel return pipe from gasoline filter, fuel connecting pipe (gasoline) , fuel injector (diesel) .

(23) Dismount heater pipe from water inlet manifold.

(24) Dismount radiator water inlet pipe and reserve tank hose from water inlet manifold.

(25) Dismount heater water inlet hose from water inlet manifold, and dismount radiator water outlet hose from water inlet pipe.

(26) Dismount vacuum flexible pipe.

(27) Dismount brake booster hose from air intake manifold. (Dismount from generator vacuum pump for 480 diesel engines) separate engine harness from chassis harness.

(28) Lift up car body.

(29) If necessary, drain engine oil.

(30) Dismount exhaust center pipe nut.

(31) Dismount cable adaptor and battery positive wire from starting motor.

(32) Dismount battery negative wire from transmission.

(33) Dismount cable adaptor of backing lamp switch.

(34) Dismount speedometer cable from transmission.

(35) Dismount cable from oil pressure alarm.

(36) Dismount exhaust manifold cover, and then remove engine earth cable from exhaust manifold.

(37) Dismount clutch cable and gear-shifting gear from clutch release arm and transmission.

(38) Dismount drive shaft.

(39) Dismount lower cover and brace.

(40) Use special lifting tool to fix engine with transmission and make it in a state of stability.

(41) Dismount engine suspension bracket bolts.

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(42) Before Using special lifting tool to lift up engine with transmission, recheck to make sure that all piping lines and cables are removed from engine and transmission.

(43) Use special lifting tool to remove engine with transmission.

(44) Dismount transmission stiffener to separate engine from transmission.

(45) Dismount engine bracket, if necessary, replace suspension swelling mat.

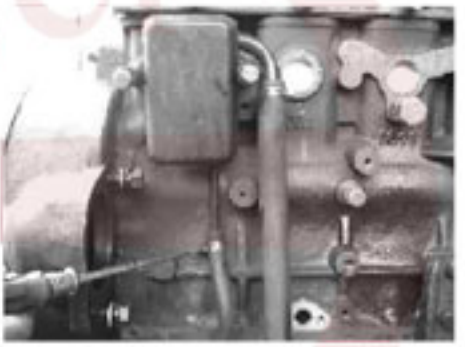
1.1.3.2 Disassembling engine

(1) Crankshaft ventilation assembly

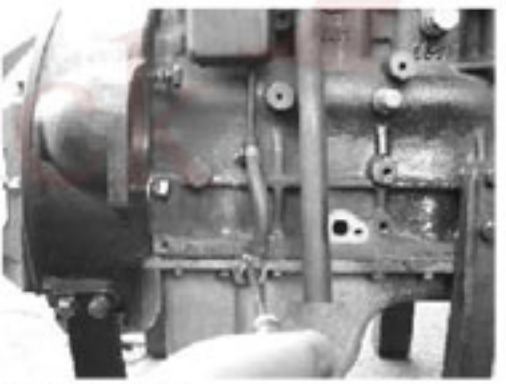
1) Dismount ventilating system right-side bolts.



2) Dismount ventilation system oil return rubber hose clamp.



3) Dismount clamp between oil return rubber hose and oil sump.



4) Dismount ventilation left-side bolts to remove throat clamp.

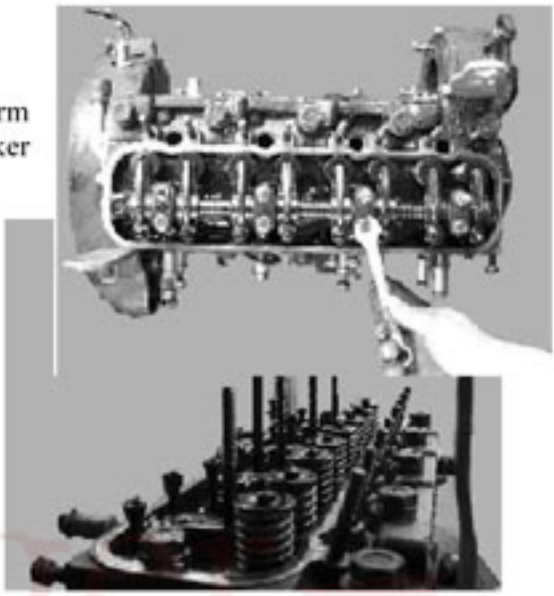


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(2) Rocker, rocker shaft and bush bar.

1) Disassemble cylinder head assembly.

2) Loosen fixing bolts between rocker arm bracket and cylinder head to remove rocker mechanism parts.



3) Remove push rod from push rod hole.

4) Loosen fixing screws and locking screws of rear rocker shaft bracket top rocker bearing to remove circlips with circlip pliers.



5) Remove rear rocker shaft bracket, rocker shaft spring and rocker assembly from rocker shaft.



6) Place rocker and rocker shaft into gasoline or other cleaning agent for



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cleaning.

7) Purge clean rocker and rocker shaft with compressed air.



(3) Cylinder head assembly, air intake and exhaust valves, cylinder head gasket

1) Remove fixing bolts between temperature regulator assembly and cylinder head; remove throat between small circulation rubber pipe and water pump; remove temperature regulator assembly together with small circulation rubber pipe.



2) Remove three fixing bolts of rear cover, then rear cover and gasket.

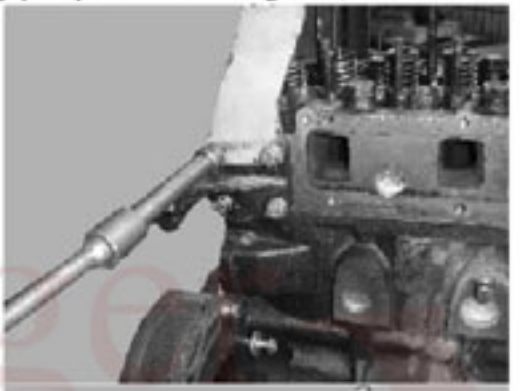


3) Remove rear carrier ring and bracket fixed on rear carrier ring.



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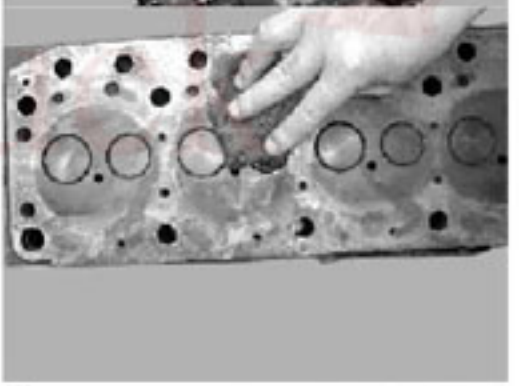
4) Loosen front carrier ring and steering pump bracket fixing bolt, and remove steering pump bracket and front carrier ring.



5) Remove ten bolts fixing cylinder head in order, and then the whole cylinder head.



6) Erect cylinder head to clean oil dirt on bottom plane.



7) Turn cylinder head bottom plane downward and loosen valve actuation parts with special tools.



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8) Remove valve spring upper seat, valve lock, and valve spring.



9) Remove valve stem sealing ring from valve guide, remove valve spring lower seat.

10) Remove intake and exhaust valves from cylinder head bottom.



11) Clean intake and exhaust valves with gasoline or other cleaning agent, purge them clean with compressed air.



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12) Remove cylinder head gasket.





13) Remove tappets from the holes.

14) Place tappets into gasoline for cleaning and purge them clean.



(4) Camshaft, all timing gears and all timing gear shafts.

1) Remove cylinder head cover.

2) Remove rocker shaft assembly.

3) Remove gear housing cover.

4) Loosen idle gear gland plate fixing bolts to remove idle gear and idle gear shaft.



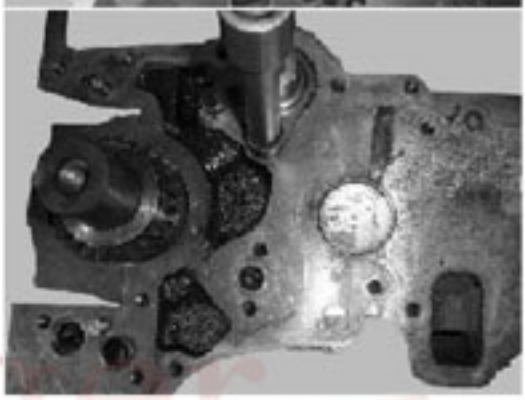


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5) Clean timing idle gear shaft in gasoline.



6) Remove camshaft timing gear fixing bolts, and then remove camshaft gear.



7) Loosen two hexes. Flanged bolts of camshaft thrust plate and cylinder block to remove thrust plate.



8) Remove camshaft.



9) Place camshaft into gasoline or other cleaning solution for cleaning and purge it clean.



(4) Piston and connecting rod assembly

1) Remove cylinder head.

2) Remove oil sump.

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3) Remove oil filter assembly.

4) Remove nozzle parts.

5) Loosen connecting rod nuts to remove connecting rod cap.

6) Push out piston and connecting rod from cylinder.



7) Remove retainers from both ends of piston pin.



8) Remove piston pin to take out connecting rod.



9) Remove connecting rod and bearing in side connecting rod cap.



10) Remove first/second piston rings and oil rings from piston ring slots.



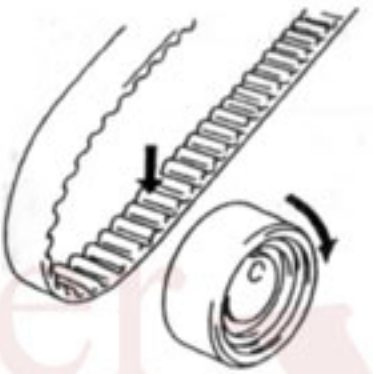
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1.1.3.3 Engine parts and components

(1) Timing belt and tensioning pulley (gasoline car)

1) Check timing belt for wear or cracks, and replace it if necessary.

2) Check whether tensioning pulley rotates smoothly and has rattling sound.

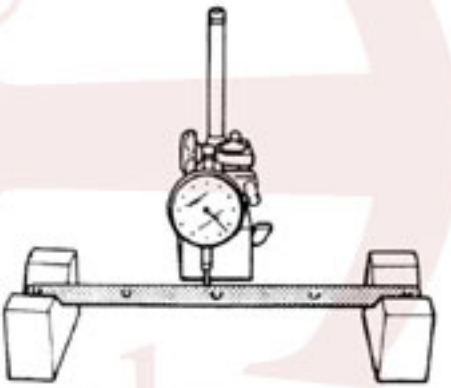


(2) Rocker shaft

1) Rocker shaft straightness

Check straightness with "v" type block and dial indicator.

If straightness is out of limit, replace it.



(2) Rocker – rocker shaft clearance

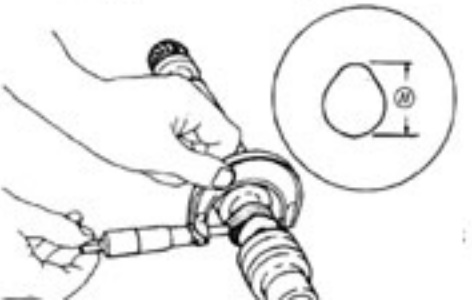
Measure rocker shaft diameter and rocker inside diameter with micrometer and internal dial gauge.

The difference between the two readings is the rocker – shaft clearance. This clearance must be within the specified scope.

If out of limit, replace shaft or rocker or both.



(3) Camshaft



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1) Camshaft wear

Measure camshaft height with micrometer; replace it if measured height is lower than the limit.

2) Camshaft straightness

Keep camshaft between two "V" type blocks, then measure straightness with dial gauge.

If straightness is out of limit, replace it.

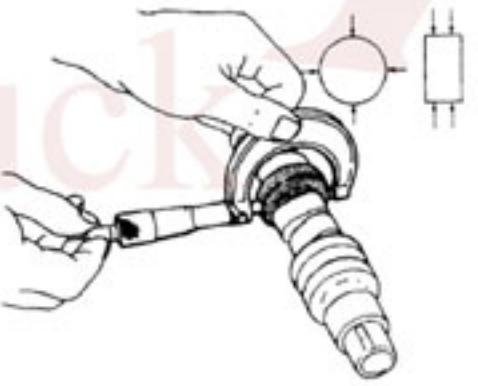




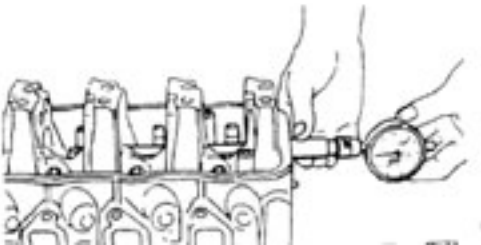
3) Camshaft neck wear

Measure four points for camshaft neck diameter to obtain four readings for each neck, then measure cylinder head camshaft hole inside diameter to get four readings.

Minus camshaft neck diameter with cylinder head camshaft hole inside diameter, then it is neck clearance.



If neck clearance is out of limit, replace camshaft. If necessary, may also replace cylinder head.

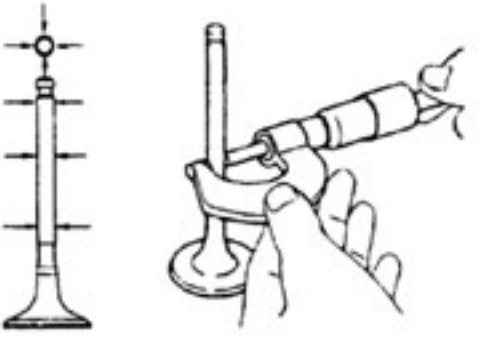


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(4) Valve guide, valve and valve spring

1) Valve guide

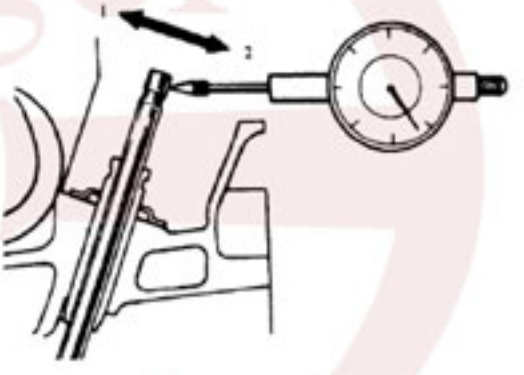
Check the clearance between valve stem and guide with micrometer and internal dial gauge, take the readings of valve stem diameter and guide inside diameter if the clearance is out of limit, replace valve and valve guide.



If internal dial gauge is not available, check deviation of valve stem top with dial gauge equipped with gauge stand.

Shake valve stem top in 1, 2 directions to measure top deviation.

If the deviation is out of limit, replace valve stem and valve guide.



2) Valve

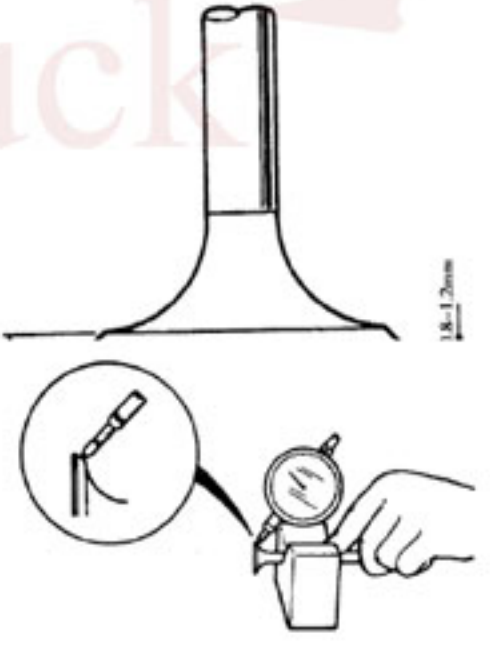
□Remove all carbon on valve.

□Check each valve for wear, ablation or any change. If necessary, replace it.

□Measure valve head thickness, and must replace valve if thickness is not up to limit.

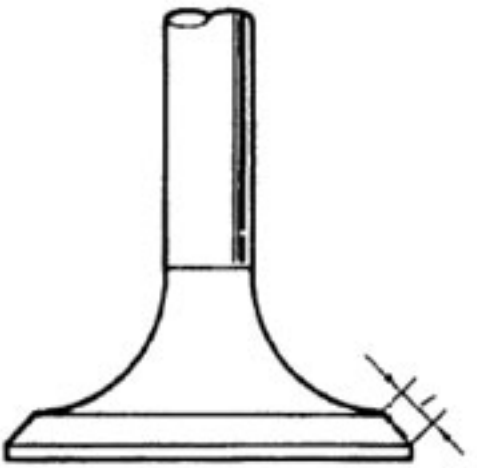
□Measure radial motion of valve head with dial gauge and "V" block.

□if radial motion is out of limit, replace valve.



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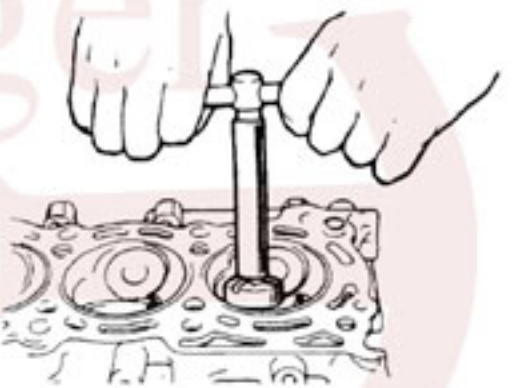
□Width of touching area between conical face and valve seat



Normally, grinding is adopted to form a kind of touching pattern, i.e. evenly apply a layer of compound on valve conical face (e.g. red lead) , and then rotate. Valve grinder must be used to grind valve, and the pattern formed after grinding on valve conical face must be a color band with interruption, the width of which must be within the following range.

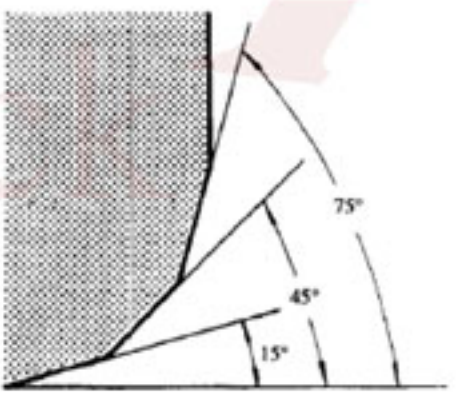
Range: width of color band: 1.3-1.5mm

□ Repair of air valve seat



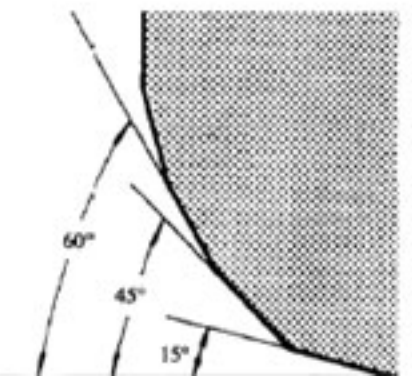
If valve seat cannot touch evenly with valve, or the touching width of valve seat exceeds the required range, grinding and fine grinding must be made again after grinding or cutting.

Exhaust valve seat: three cuttings should be made by using valve seat cutting tools as shown in the Fig. First cutting is 15°, second cutting is 60°, and third cutting is 45 ° which must produce a touching width of conical face that conforms to requirement.



Air intake valve seat: cutting sequence is the same as that of exhaust valve seat.

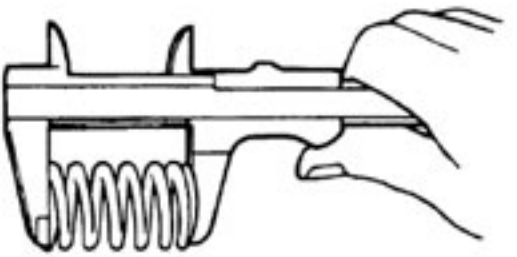
Width of intake valve seat	1.3-1.5mm



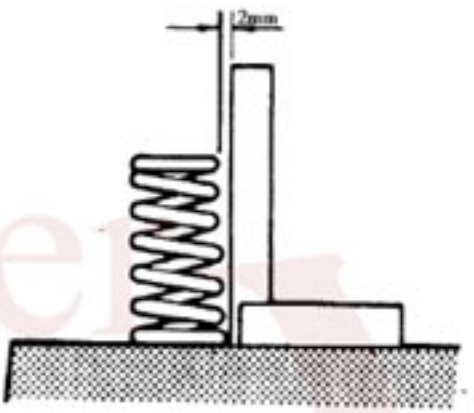
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3) Valve spring

Measure free length of valve spring with vernier caliper. When spring free length is smaller than the limit, replace valve spring.



Spring verticality: check verticality of each spring with vertical ruler and plane table, i.e. measure clearance between end face of valve spring and ruler. If verticality of valve spring is found out of limited gap width, then valve spring must be replaced.



Valve spring verticality limit	2.0mm (0.079in.)

(5) Cylinder head

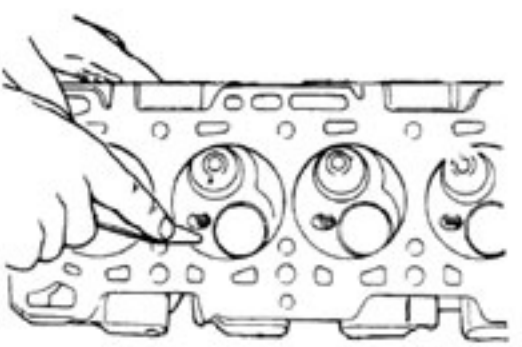
1) Clean the surface of cylinder head.

Remove gasket material and seal gum on cylinder head surface.

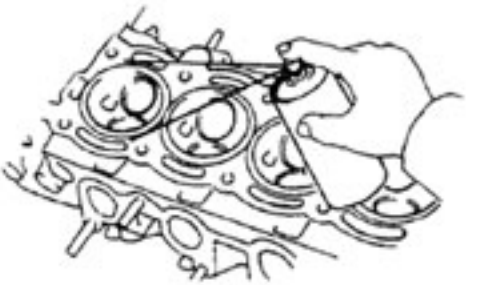


2) Remove carbon of combustion chamber.

Remove carbon of cylinder head combustion chamber.



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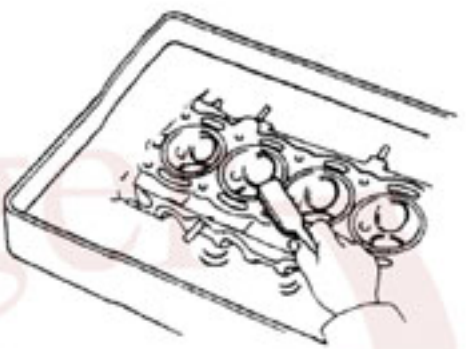


Remove carbon of cylinder head combustion chamber with plastic sheet.



3) Clean cylinder head.

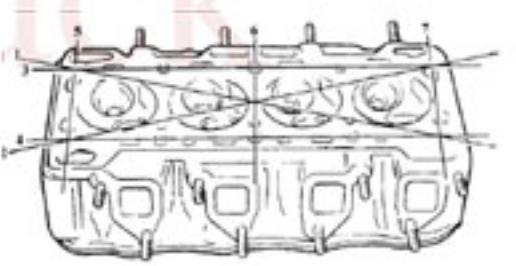
Thoroughly clean cylinder head surface with soft brush.



4) Check cylinder head for cracks.

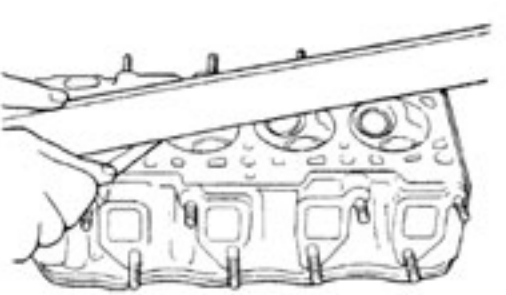
Check cylinder head surface for crack with dye penetration method.

5) Check the flatness of joining surface of cylinder head gasket.



Check cylinder head joining surface for any deformation with straight edge ruler and feeler gauge.

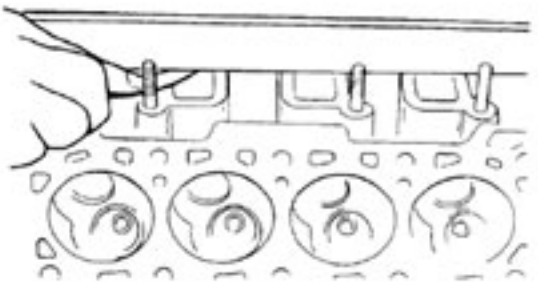
If any deformation is found on cylinder head joining surface is found out of limit,



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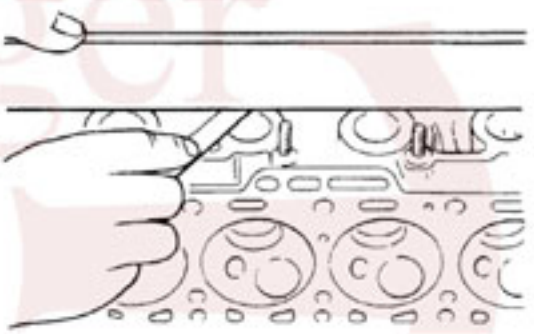
replace it or repair it by grinding.

Flatness limit	0.05mm



6) Check intake and exhaust manifold joining surface for any deformation.

Check cylinder head intake (exhaust) manifold joining surface with straight edge ruler and feeler gauge to confirm whether the surface must be repaired by grinding, or cylinder head must be replaced.



Flatness limit	0.10mm

(6) Cylinder block

1) Top flatness

Check cylinder block top face for any deformation with straight edge ruler and feeler gauge. If deformation is out of limit, rectify it.



Item	Standard	Limit
Flatness	0.03mm	0.05mm

2) Measurement of bore wear

Measure bore wear with bore gauge. If bore wear exceeds limit, it should be repaired by boring to increase bore diameter to repair dimension.

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Note: If one of the four bores needs enlargement, all other bores should be bored to enlarged dimension which must be the same.

Calculate bore diameter for boring again.

D=A+B-C

Where: D ---- cylinder diameter for boring again

A – Measured piston diameter

B – Clearance between piston and cylinder wall

C – Grinding surplus = 0.02mm (0.008in.)

(7) Piston, piston pin, piston ring and connecting rod

Piston



□ Check piston for any abnormal wear and cracks etc. if any, must replace.

□ as shown in the Fig. piston diameter must be measured at H=15mm above piston apron in the direction perpendicular with piston pin hole.

□ Piston clearance:

To determine piston clearance, bore diameter and piston diameter must be measured. Piston clearance is the difference between bore diameter and piston diameter, and must be within the following required scope.

If piston clearance is out of the scope, cylinder must be bored again, and enlarged dimensions must be used.

Piston clearance:	0.02-0.04mm

□ Piston ring groove clearance:

Before checking, piston ring groove must be cleaned, dried and carbon removed. Install new piston rings into piston ring groove, measure clearance between piston and piston ring groove with feeler gauge. If the clearance is out of limit, replace piston or piston ring as necessary.



2) Piston pin

□ When piston pin is in room temperature, it should be easily fixed into piston pin bore by pushing with finger.



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□ Check piston pin, small end pin bore of connecting rod and piston pin bore for any wear and damage, and special attention should be given to small end bushing. If piston pin, small end pin bore of connecting rod and piston pin bore are seriously worn or damage, replace piston pin, connecting rod or piston.

□ Piston clearance:

Check small end piston pin clearance. If the small end is seriously worn or damaged, or its clearance is found out of limit, replace it.

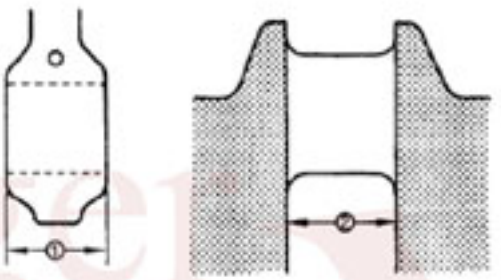
3) Piston ring

When piston ring is installed into cylinder, check its gap with feeler gauge. If the gap is out of limit, replace piston ring.

4) Connecting rod

□ Measure connecting rod big end thrust clearance.

When connecting rod is normally assembled, measure thrust clearance between connecting big end and crankshaft with feeler gauge. If the thrust clearance is out of limit, replace connecting rod or crankshaft.



□ Check connecting rod for any deformation.

Check connecting rod for any bend, torsion and deformation with connecting rod calibrator, three-point gauge and feeler gauge. If deformation exceeds limit, replace connecting rod.

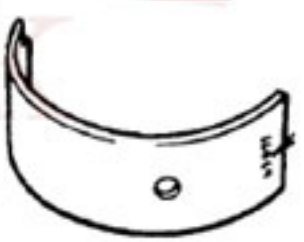
Bending deformation limit: 0.05mm

Torsion deformation limit: 0.10mm

(8) Connecting rod bearing

□ Visual inspection of connecting rod bearing

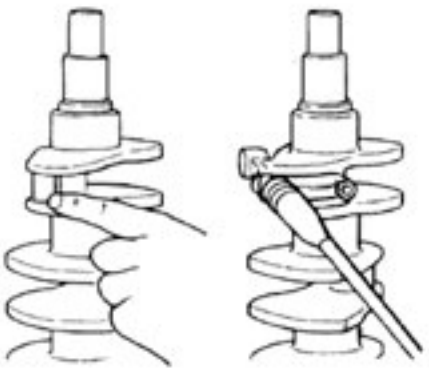
Check connecting rod bearing surface for any recesses, ablation and peeling active serious defects are found, replace it.



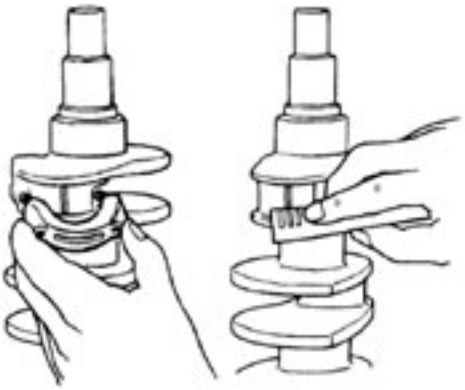
□ Measurement of connecting rod bearing clearance

When connecting rod cap and connecting rod are normally assembled, tighten bearing cap bolts and measure fit clearance between bearing and shaft journal with plastic feeler gauge or thin fuse. If the clearance is too big, smaller bearing can be used, and shaft journal is ground to smaller size.

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Installation of gap feeler gauge

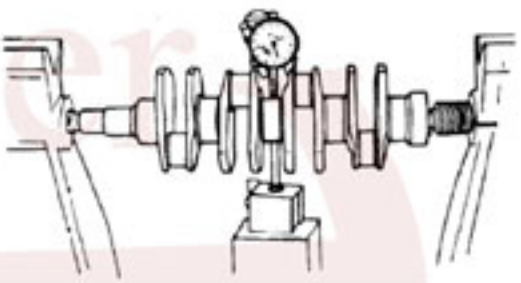


measurement of fit clearance

(9) Crankshaft

1) Camshaft straightness

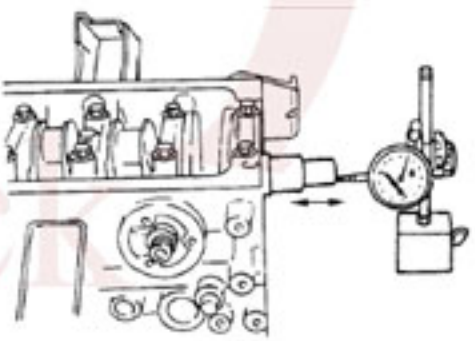
Measure central-located shaft journal offset with micrometer. Slowly turn camshaft and if straightness is out of limit, replace camshaft.



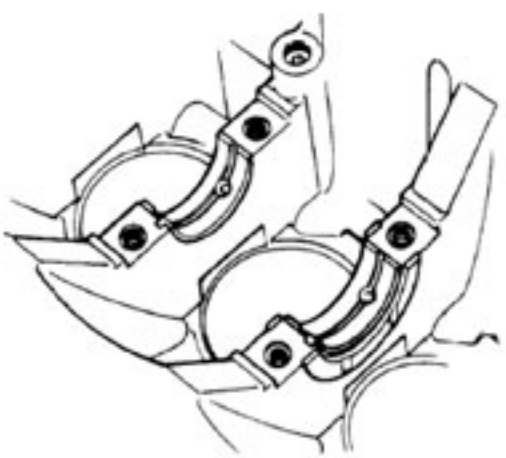
Straightness limit	0.06mm

2) Camshaft thrust clearance

Correctly assemble main bearing and main bearing cap as well as thrust plate, then tighten them with required torque, and measure camshaft thrust clearance in normal way.



If thrust clearance exceeds limit, replace with thrust plate of new standard dimension or enlarged dimension, so as to meet the requirements on thrust clearance.



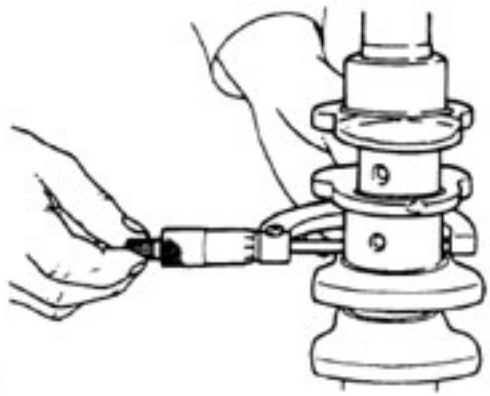
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Camshaft thrust plate thickness	Standard	2.500mm
	0.125mm	2.563mm
	0.250mm	2.625mm

3) Journal wear evenness inspection

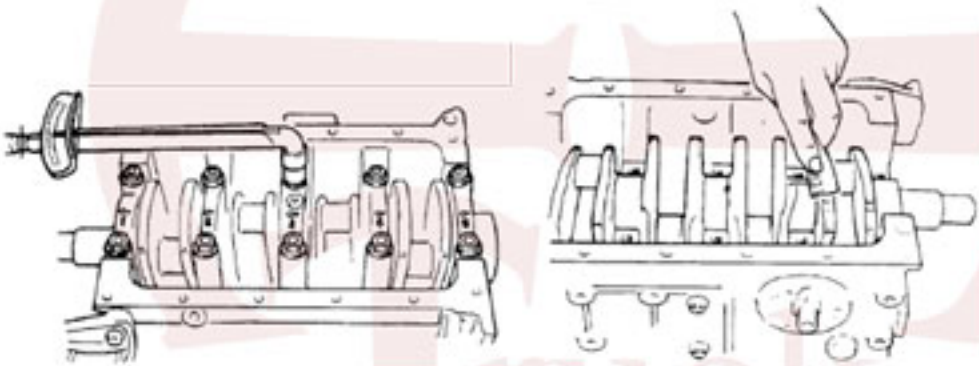
Check it for any deformation or conical contour by measuring on camshaft journal and connecting rod journal with micrometer screw gauge. If any, grind or replace camshaft.

Wear unevenness limit: 0.01mm



4) Inspection of fit clearance between main journal and main bearing

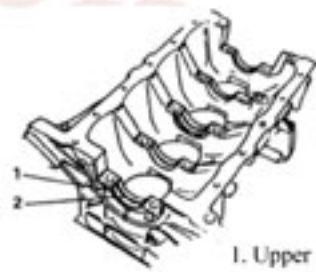
When main bearing cap and camshaft are normally assembled, tighten bearing cap bolts, and measure the fit clearance between main bearing and journal with plastic feeler gauge or thin fuse. If the clearance is too big, smaller bearing can be used, and journal should be ground to smaller size.



(10) Main bearing

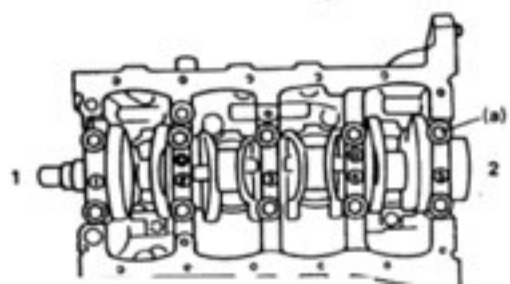
1) General description

Upper bearing has oil groove on it as shown in Fig. Fix it onto cylinder block.



1. Upper bearing
2. Oil groove

Each main bearing is stamped with arrow mark and No. as indicated in the Fig. When bearing is installed, arrow mark should point to camshaft

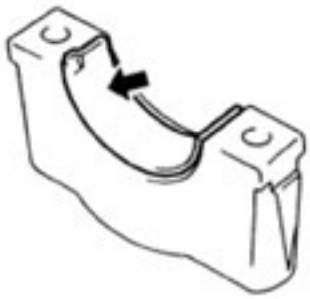


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pulley side, from which fix bearings in the order of 1.2.3.4.5. and tighten bearing cap bolts to required torque.

2) Check

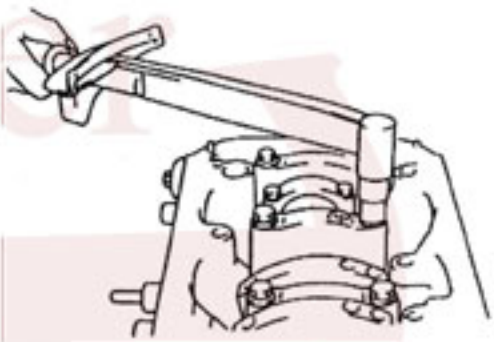
Check bearing for any rust, scratch, wear or damage. If found not normal, replace upper and lower bearing, and can never replace only half bearing.



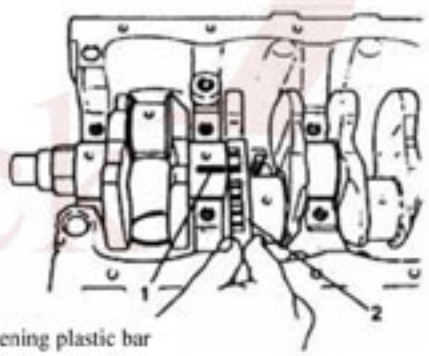
3) Main bearing clearance

Check clearance with plastic feeler gauge according to following procedure.

- Disassemble bearing cap.
- Clean bearing and main journal.
- Place a plastic feeler gauge of same width with bearing (parallel with crankshaft) onto journal, avoiding oil hole.



- Assemble main bearing according to the proceeding method, and tighten bearing cap bolt to required torque. Bearing cap must be tightened to required torque to assure correct readings.
- Disassemble bearing cap, and measure the width of plastic straightening strip at the widest point by using the scale on plastic straightening strip. If the clearance exceeds its limit, replace the bearing. Replace upper and lower bushes with the bearing.



1. Straightening plastic bar
2. Gauge

(11) Rear oil seal

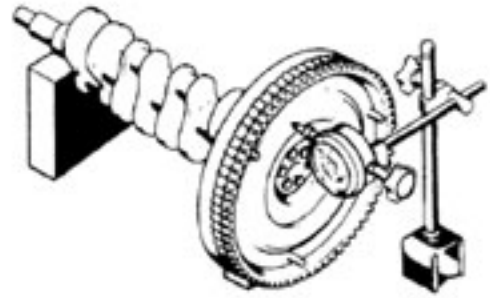
Carefully check oil seal for any wear or damage. If oil seal lip is worn or damaged, replace oil seal.



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(12) Flywheel

1) If annulus ring is damaged, cracked and worn out, replace it.

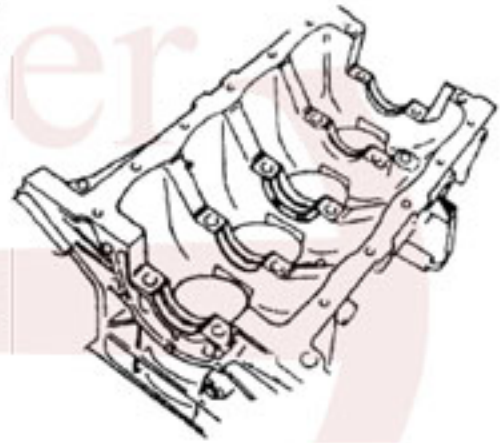


2) If clutch disc surface is damaged, or seriously worn, replace it.

3) Check flywheel end face for any oscillation with micrometer If end face oscillation exceeds limit, replace flywheel. Oscillation limit of flywheel end face: 0.2mm

1.1.3.4 Assembly of major parts and components

Engine assembly procedure is contrary to that of disassembly, but certain methods must be taken to assure reassembled engine can meet ex-work requirements.

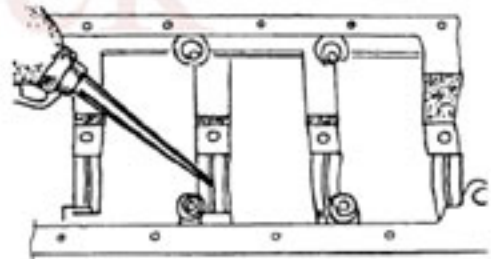


(1) Crankshaft

1) Fix main bearing onto cylinder block.

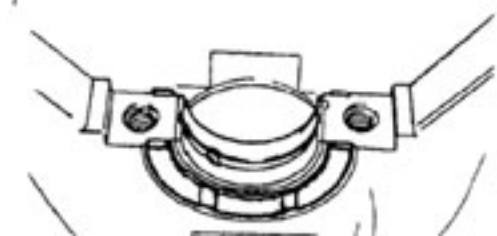
One of the two main bearings has oil groove on it. Fix the bearing with oil groove onto cylinder block. Fix the bearing without oil groove to main bearing.

Make sure both bearings have the same color.



2) Filling-up of lubricating oil

Add certain amount of QE20W/40 oil to oil groove of main bearing.



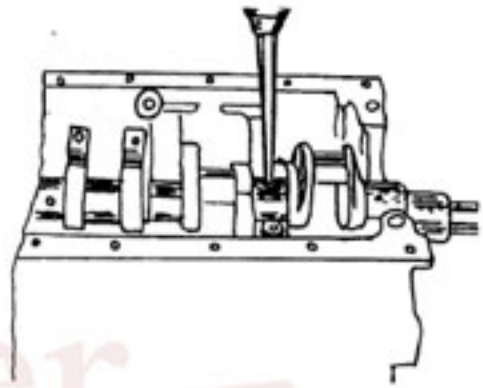
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3) Fix camshaft thrust plate.

Fix camshaft thrust plate to both sides of main bearing between No.2 and No.3 cylinders of the block, with thrust plate's oil groove facing camshaft arm.

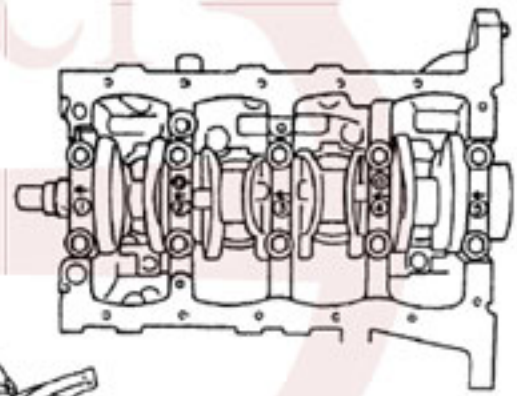
4) Fix camshaft and lubricate main journal.

Place camshaft onto cylinder block, and fill lubricating oil to main journal.



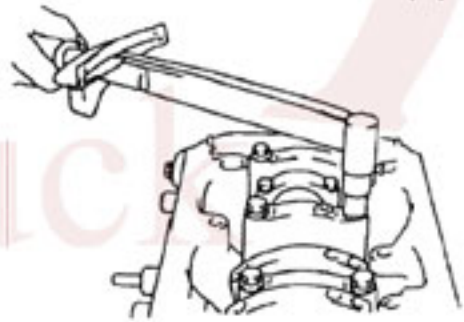
5) Fix main bearing cap.

Place main bearing caps on main bearing carriers from belt pulley in the order of 1.2.3.4.5, with arrow mark aligned with camshaft belt pulley side.



6) Tightening of main bearing caps

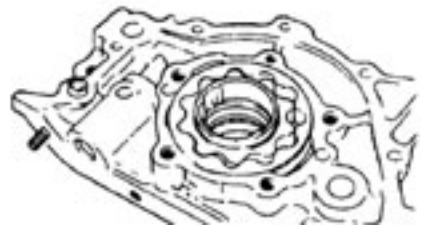
Evenly and gradually tighten fixing bolts of main bearing cap with torque wrench to required torque.



(2) Oil pump and rear end cover

1) Clean and air dry all parts and components.

2) Apply a thin layer of engine oil onto inner/outer rotor, oil seal lip, and inside surfaces of oil pump

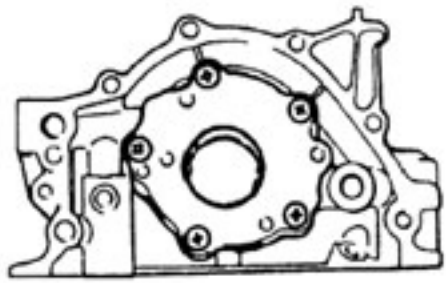


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case and end plate.

3) Fix outer/inner rotors onto pump case.

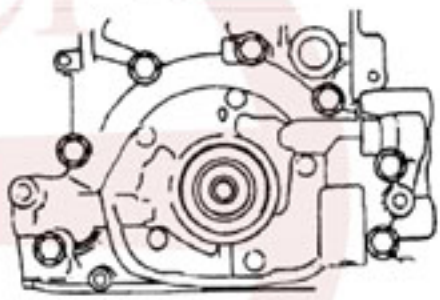
4) Fix rotor end plate and tighten 5 screws. After end plate is fixed, check and make sure that rotor can run smoothly.



5) Evenly apply sealing gum onto new sealing gasket surface, and fix oil seal guide to camshaft.

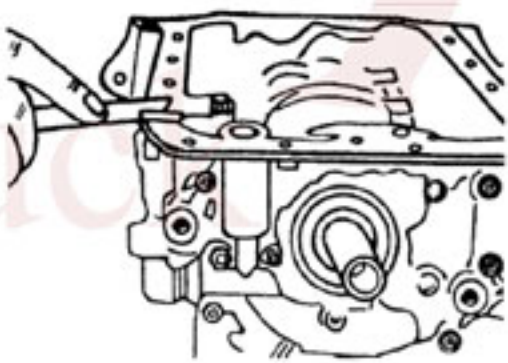


6) Fix oil pump to camshaft and cylinder block, tighten fixing bolts, and then disassemble oil seal guide.



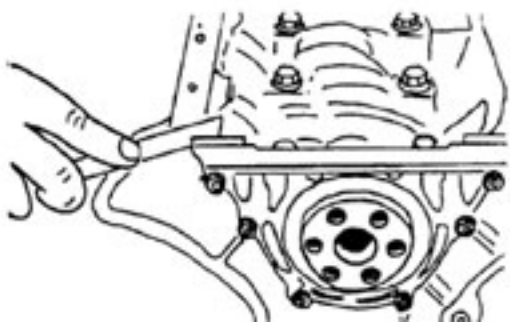
7) Oil pump sealing gasket edge may bulge.

If this happens, use sharp knife to cut to make it smooth and flush with pump case and cylinder block.



8) Fix rear end cover and sealing gasket.

Install new seal gasket. No disassembled sealing gaskets should be reused. Before fixing, apply oil to seal gasket lip. Tightened rear cover bolts according to required technical conditions. After rear



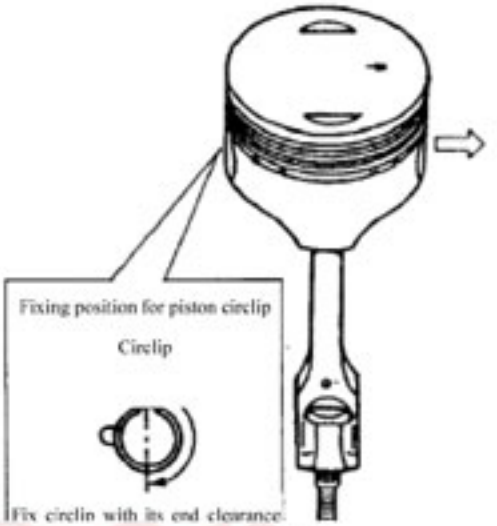
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cover is installed, seal gasket edge may bulge; if so, cut it off and make it flushes with cylinder block and rear end cover.

(3) Piston and connecting rod

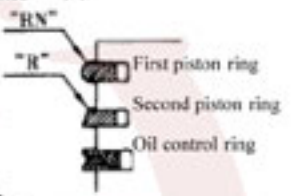
1) Fix piston pin to piston and connecting rod.

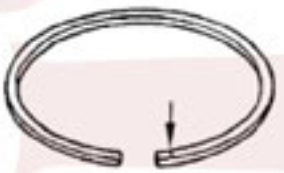
After applying engine oil to piston and piston pin inside piston and connecting rod, assembly connecting rod and piston as shown in the Fig. insert piston pin into piston and connecting rod, and then fix piston pin circlip.



2) Fix piston ring to piston.

First and second piston rings have "RN" and "R" marks as shown in the Fig. When piston rings are installed to piston, the mark side of each piston ring should align with piston head.

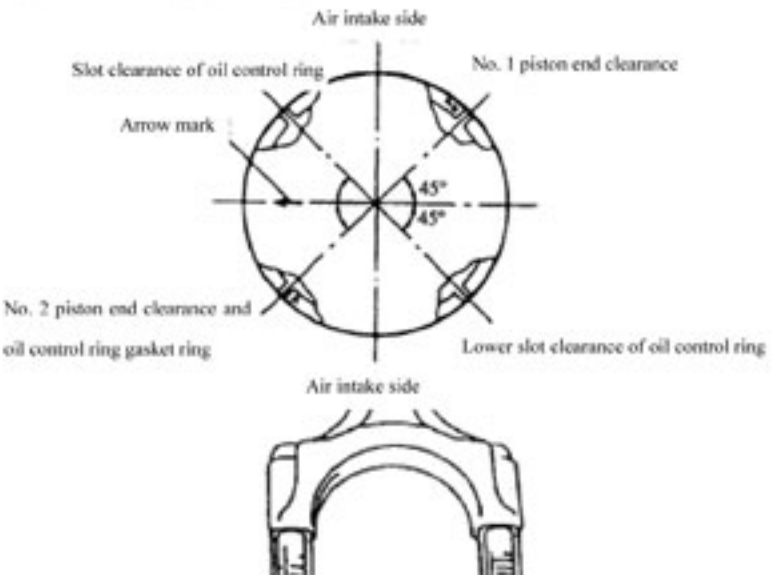




No.1 and No. 2 piston rings have differences in thickness, shape and cylinder wall contacting surface color. Distinguish NO.1 piston ring and No. 2 piston ring according to reference Fig.

When oil control rings are installed, first install gasket and then two oil control rings.

3) After No. 1, No.2 piston rings and oil control rings have been installed, adjust their clearances as shown in the Fig.



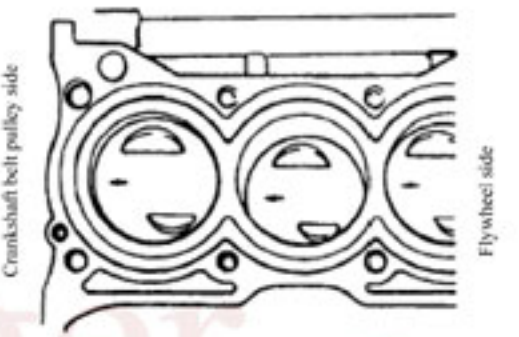
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4) Apply engine oil to piston, piston rings, cylinder wall, connecting rod bearing and crankshaft pins.

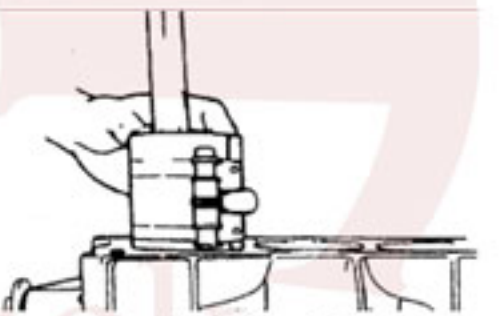
5) Assembly soft guide to connecting rod bolts.

When connecting rods and piston assembly is installed, these guides can protect thread of camshaft pins and connecting rod bolts from being damaged.

6) When piston and connecting rod are installed into cylinders, be sure that the arrow mark on piston head faces camshaft belt pulley side.



7) Install piston rings, piston and connecting rod assembly into cylinder with piston ring compressor.



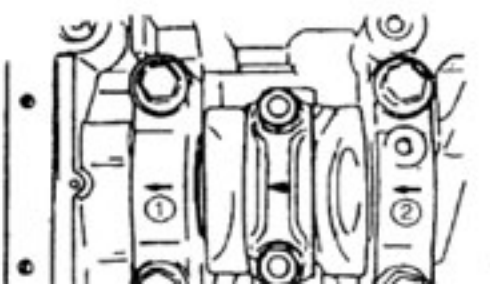
8) Fix connecting rod bearing to connecting rod bearing cap in line with requirements.



9) Fix connecting rod bearing cap.

Make arrow mark on bearing cap facing camshaft belt pulley side.

Tightened bearing cap nuts according to



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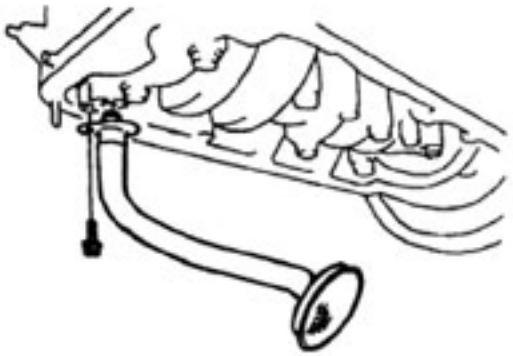
required technical conditions.

(3) Install oil pump filter.

1) Installation of oil pump filter

Fix sealing parts to the positions as shown in the Fig.

First tighten filter bolts, and then tighten bracket bolts to required torque.



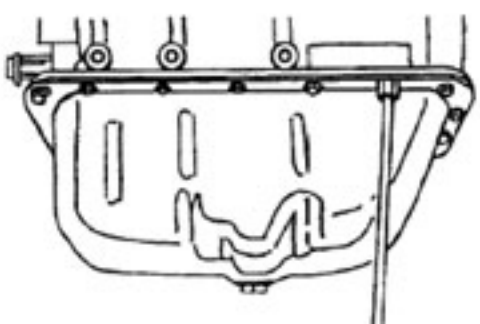
2) Clean upper and lower surfaces of oil pan and assembling surface of cylinder block. Remove oil, old sealing gum and dust from assembling surfaces. After cleaning, continuously apply silicon sealing gum to assembling surface of oil pan, as shown in the Fig.



3) Evenly apply silicon sealing gum to both sides of sealing gasket.



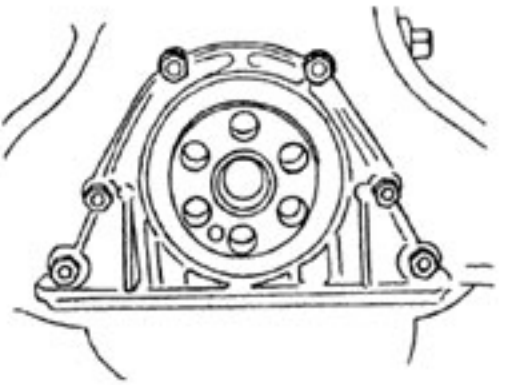
4) Fix sealing gasket to cylinder block, install oil pan, and tighten bolts. When bolts are tightened, tighten bolts from the middle of oil pan with spanner moving outward, and tighten one bolt each time.



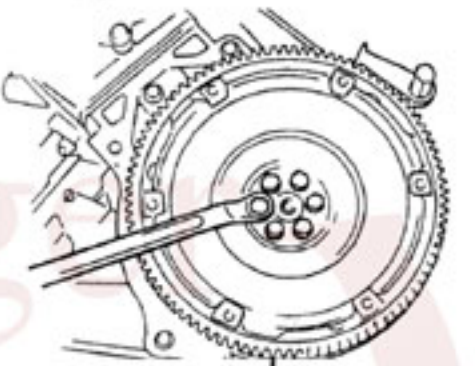
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(4) Flywheel

1) Fix flywheel pin to camshaft rear end flange; fill grease into transmission input shaft bearing port to 60% of the container.

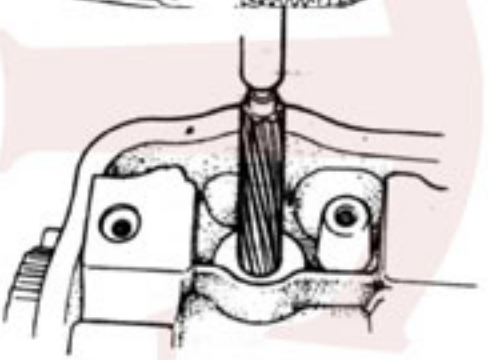


2) Fix flywheel to camshaft flange pan, install flywheel stopper and tighten fixing bolts.



(5) Cylinder head

1) Before valve guide is installed into cylinder head, trim valve guide hole to clean burrs and make the hole rounder with reamer.



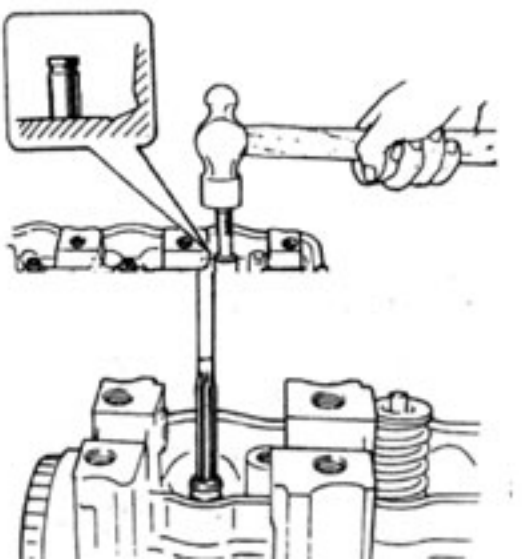
2) Installation of valve guide

Evenly heat cylinder head to 80℃-100℃, then use special tool to press new valve guide into valve guide hole.

Press new valve guide into valve guide hold until special tool touches cylinder head. After installation is completed, be sure that valve guide projection is up to requirement.

Valve guide projection: 14mm

3) Use reamer to trim valve guide hole.

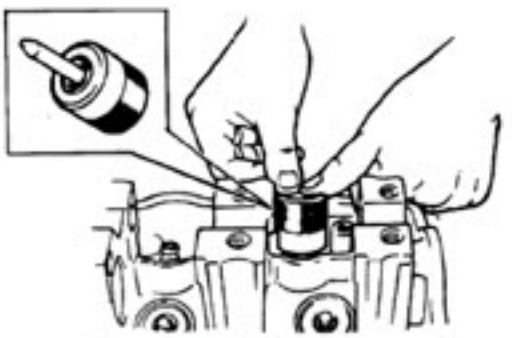


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After completion, clean the hole.

4) Install valve stem oil seal.

Apply engine oil to oil seal and installer shaft, fix oil seal onto installer shaft, and then press it into cylinder head hole.



5) Installation of valve

Apply engine oil to valve stem and valve guide wall, and install matched and lapped intake/exhaust valves to cylinder head.

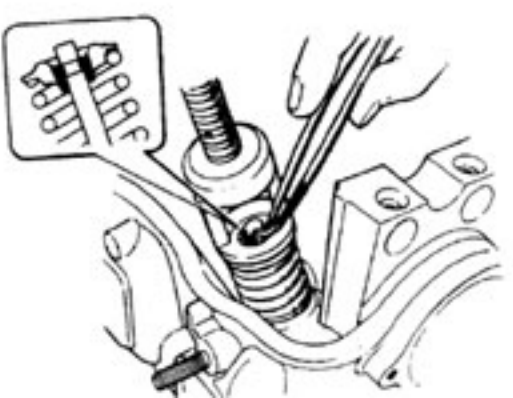


6) Installation of valve spring

Place valve spring on valve spring seat of cylinder head with big pitch end facing upward, and small pitch end facing downward.

7) Installation of valve spring lock

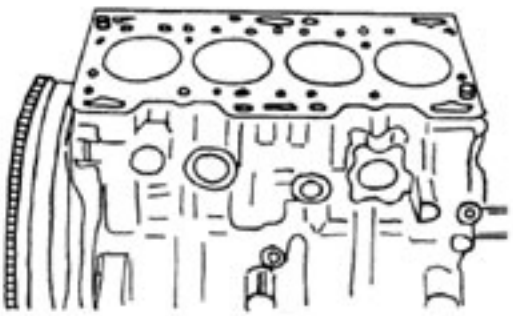
Use special extractor to press valve spring and fix spring lock into valve stem groove.



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8) Installation of cylinder head alignment pins

Fix two alignment pins of cylinder head to cylinder block.

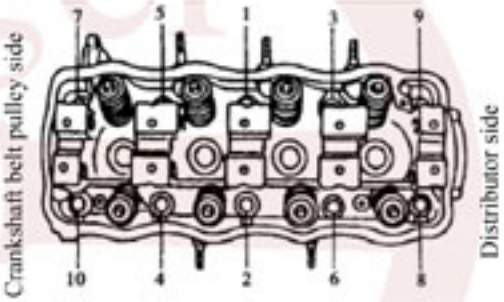


9) Installation of cylinder head gasket

Steadily place cylinder gasket on cylinder block. Make cylinder gasket top mark "TOP" facing camshaft pulley side, and side mark "EX" facing exhaust side, and "IN" facing intake side.

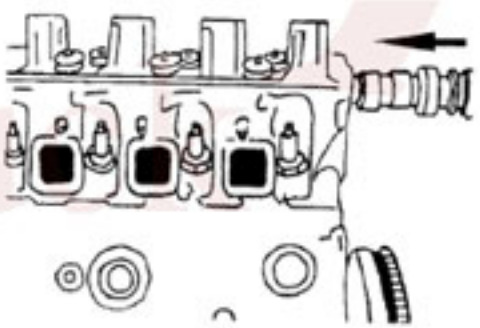
10) Installation of cylinder head.

After applying engine oil to cylinder head bolts, fix cylinder head to cylinder block and tighten cylinder head bolts to required order and torque.



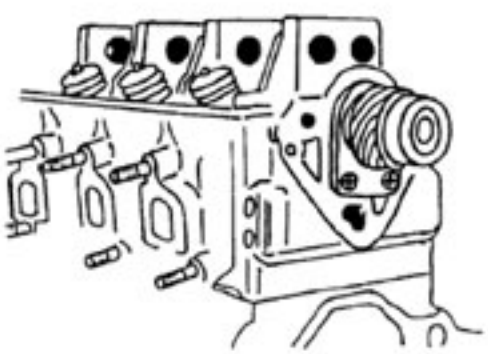
11) Installation of camshaft

Apply engine oil to cams and journals of camshaft and cylinder head oil seal, and fix camshaft to cylinder head from transmission case side.



12) Installation of camshaft thrust plate

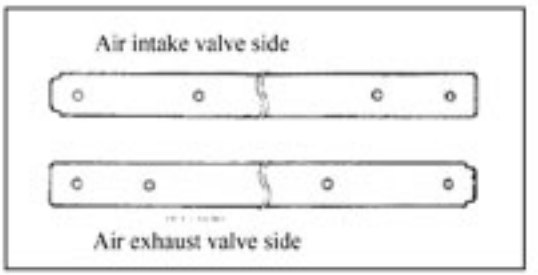
When camshaft is installed in position, fix thrust plate to cylinder head rear end and be sure that camshaft can move freely.



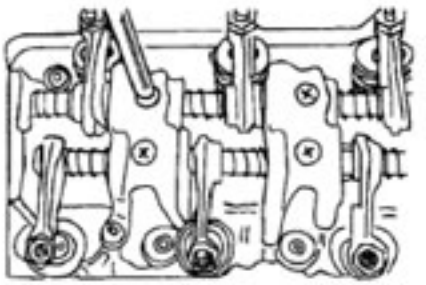
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13) Installation of rocker shaft

Apply engine oil to rocker and rocker shaft, then install rocker shaft, rocker, and rocker spring to cylinder head in order, and attention should be given to installation direction of rocker shaft. Intake rocker arm shaft should be installed with its boss facing forward, and that of exhaust rocker arm shaft facing backward, Never reverse.



14) Installation of rocker arm shaft screws



(6) Timing belt pulley of camshaft and crankshaft

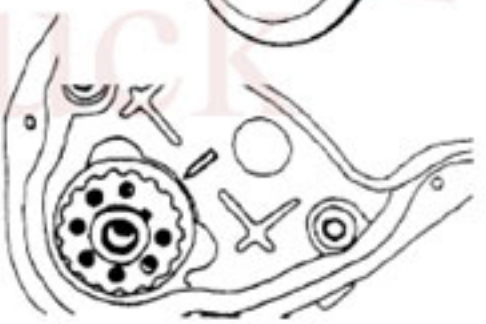
1) Installation of timing belt pulley retainer

Fix retainer to crankshaft with its inner recess facing cylinder block, and outer recess facing belt pulley.



2) Installation of timing belt pulley of crankshaft

Install woodruff key with crankshaft timing belt pulley key aligning with crankshaft key slot, then turn crankshaft timing belt pulley to make it aligned with timing mark"→"on the housing.



3) Adjustment of crankshaft rotating angle

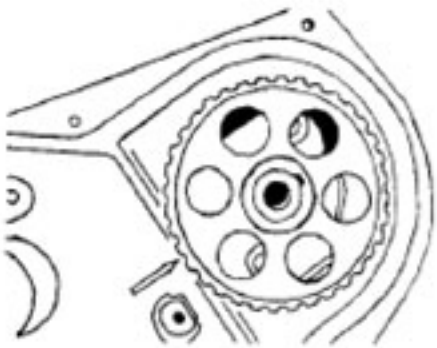
When camshaft timing belt pulley is installed, first turn timing belt pulley key slot to the scope of 80-100°.



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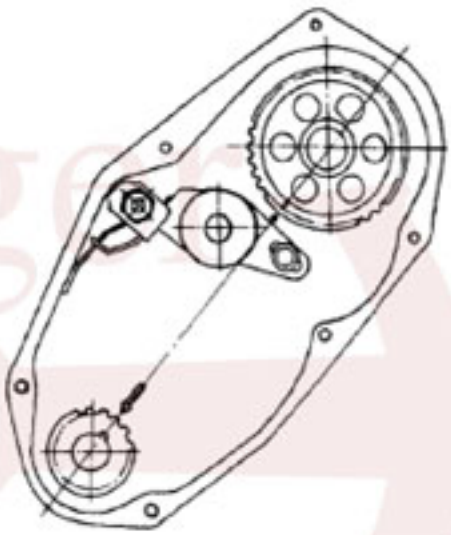
4) Installation of camshaft timing belt pulley

When camshaft timing belt pulley key slot is turned to 80°-100°, align camshaft timing belt pulley key slot with gear round mark, and then fix camshaft timing belt pulley to camshaft.



5) Installation of tensioning wheel assembly

Fix tensioning wheel to assembling stand, tighten bolts and nuts, and be sure that tensioning wheel can be turned rather easily by hand.



6) Installation of timing belt

After assembling marks of both camshaft timing belt pulley and camshaft timing belt pulley are aligned with each other, and are in one straight line, fix timing belt to two timing gears. Adjust belt flexibility, tighten tensioning wheel bolts, and apply sealing gum to fixing bolts.

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1.2 Fuel System

1.2.1 Structure and Maintenance of Fuel System

1.2.1.1 YD480

The fuel feed system consists of fuel feed pump, fuel filter, injection pump, speed governor, fuel injector and fuel line, as shown in Figure 1.2 - 1.

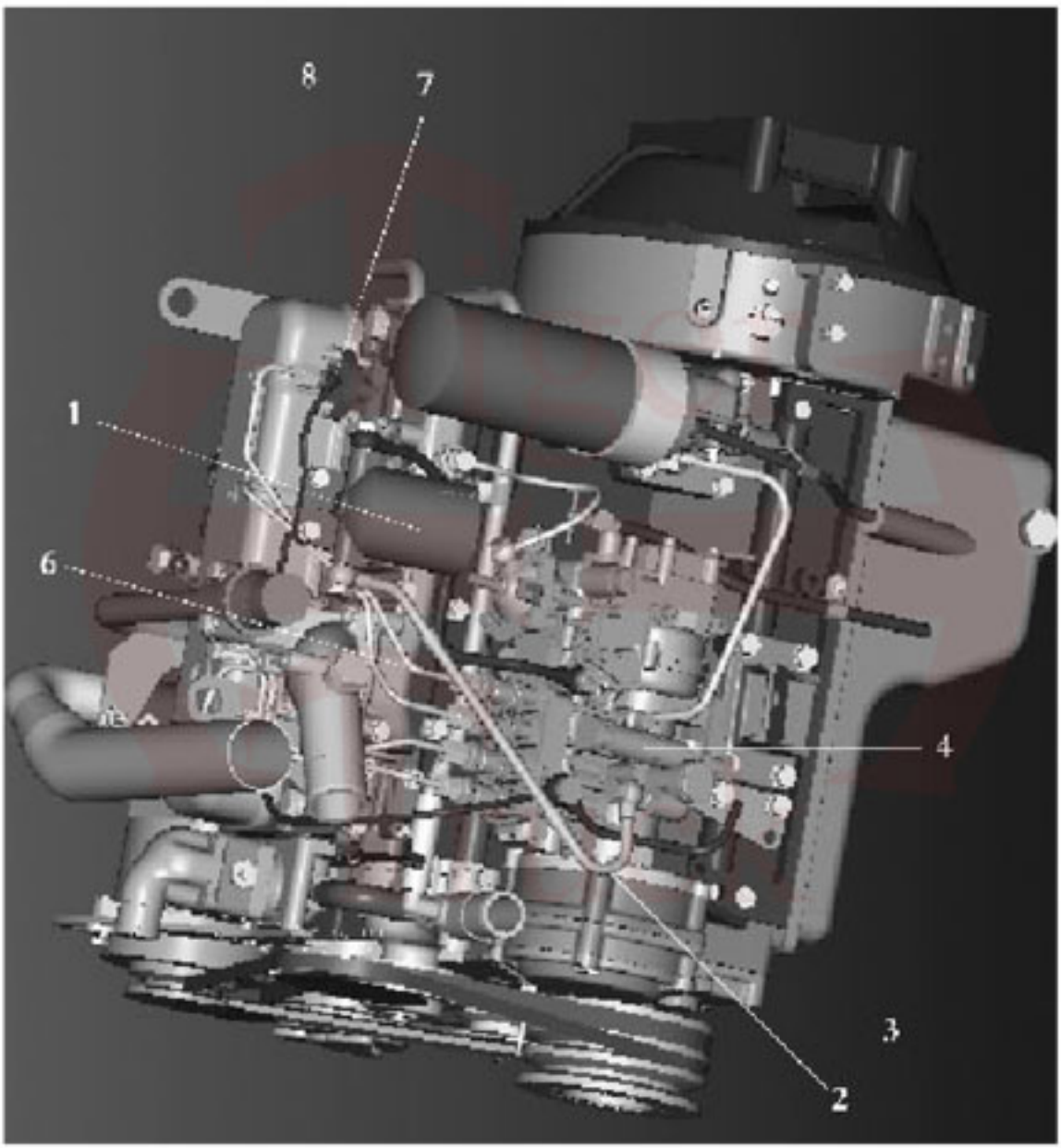


Figure 1.2 - 1 Air intake system of fuel feed system

1. Fuel filter; 2. Fuel tube - to injection pump; 3. Fuel tube - to fuel filter; 4. Fuel feed pump; 5. Injection pump; 6. High pressure pipe; 7. Return tube of injector; 8. Fuel injector

When the diesel engine works, the fuel feed pump drinks fuel from the fuel tank, and delivers to the fuel filter, and then the fuel enter into the injection pump after filtration.

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The fuel should be pressurized in the injection pump, and be delivered into the fuel injector through the high pressure pipe according to the needed fuel quantities of different work conditions. At last, the fuel should be injected to the combustion chamber by spraying through the hole of the fuel injector. A little fuel flowed from the fuel leakage pipe of injector will pass through the return coupling of the injection pump and flow to the fuel tank after merged with the scavenge fuel of the injection pump.

(1) Low pressure fuel pipe, supercharge compensator pipe, and lubricating oil pipe

1) Explanations

□ The low pressure fuel pipe refers to the fuel feed pipe and the return tube of the injector.

□ There are two fuel feed pipes in total, one is used for delivering the fuel which output by feed pump to the fuel filter, and the other is used for delivering the filtered fuel to the intake chamber of the injection pump. The return tube of the injector can deliver the redundant fuel which flowed from the injector back to the return coupling of the injection pump, and then deliver it to the fuel tank.

□ The supercharge compensator pipe is used for introducing the air at the compressor outlet of the supercharger to the fuel compensator of the injection pump, so that the injection pump can regulate the fuel feed along with the boost pressure change of the diesel engine.

□ The lubricating oil pipe is used for introducing the lubricant in the duct of the oil filter seat to the injection pump and the parts inside of the lubricant pump.

2) Replacement and maintenance

□ Disassembling

Remove the fuel feed pipe between the feed pump and the fuel filter.



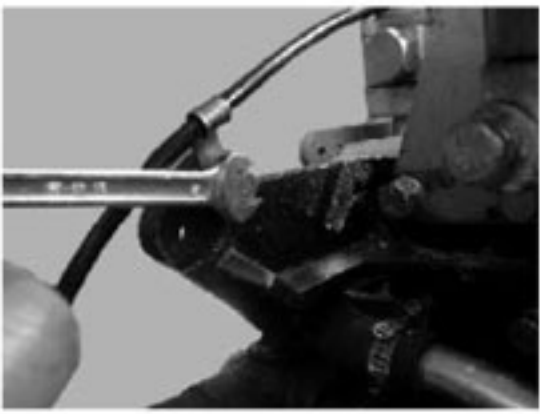
Remove the fuel feed pipe between the fuel filter and the injection pump.



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Remove the return tube clip between the injection pump and the injector.

Remove the return tube between the injector and injection pump.

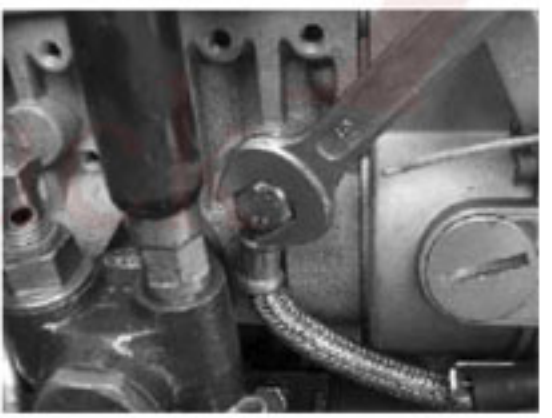


Remove the pipe of supercharge boost compensator between the air intake pipe and injection pump.



Remove the lubricating oil pipe between the oil filter seat and injection pump.

Note: When disassembling the above pipe, please clean the outside surfaces of all the couplings and the spare parts to avoid the extraneous matter entering into the fuel system.



□ Installation

Install the fuel feed pipe between the feed pump and the fuel filter.

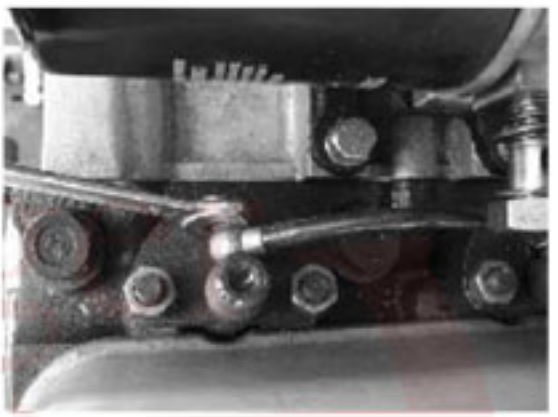


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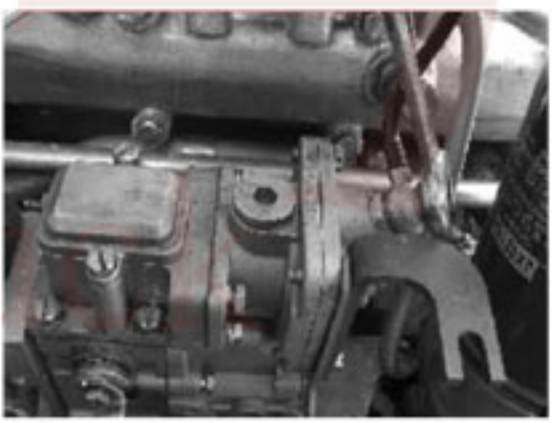
Install the fuel feed pipe between the fuel filter and the injection pump.



Install the return tube of the injector between the injector and the injection pump.



Install the pipe of supercharge boost compensator between the air intake pipe and injection pump.



Install the lubricating oil pipe between the oil filter seat and injection pump.



(2)High pressure pipe assembly

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1) Explanations

□ The high pressure pipe is used for piping the high pressure fuel which pressurized by injection pump into the injector through the high pressure pipe.

□ The four high-pressure pipes are different in shape but equivalent in length. They should be clamped in different positions with some pipe clamps. The pipe clamps can fix the high pressure pipe in position, and reduce vibration of the high-pressure pipe.

2) Replacement and repairing

□ Disassembling

Loosen the bolt of the high pressure pipe clamp, and then remove the high pressure pipe clamp.



Loosen the connecting nuts for the high pressure pipe, injection pump and injector, and then remove the high pressure pipe.



□Installation

Connect the connecting nuts on the ends of the high pressure pipe with the injection pump and the fuel inlet of the injector, and then tighten the nuts.



Tighten the bolts for the high pressure pipe clamp in the original installation position.



(3)Fuel filter

1) Explanations

□ The fuel filter is used for filtering the impurity and the moisture in diesel fuel to guarantee the diesel fuel kept clean.

□ The filter element of the fuel filter should be replaced when the automobile runs every 10,000 kilometers, or the diesel engine runs every 100 hours.

□ This section mainly represents the replacement of the filter element of fuel filter.

2) Replacement and repairing

□ Disassembling

Detach the joint of the connecting pipe of the fuel filter, and then slacken the filter element out.



□ Installation

Spread the clean engine oil on the rubber O ring of the filter element thinly and evenly; tighten the fuel filter; install the joint of the connecting pipe of fuel filter, and then screw the connecting nut.

(4)Injector assembly

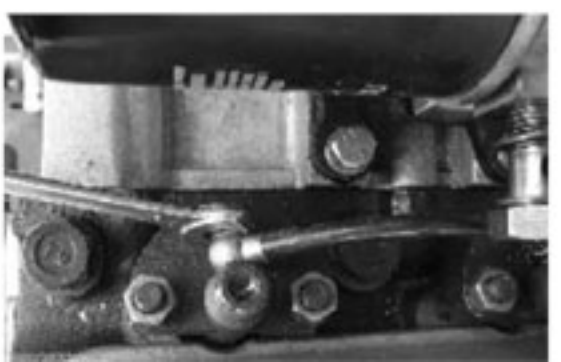
1) Explanations

The injector spays the fuel oil which piped by high pressure pipe to the combustion chamber with certain pressure, speed and direction, and makes the vapor fuel oil distributed suitably in the combustion chamber, so that the oil mist can mix with the air and burn easily.

2) Replacement and repairing

□ Disassembling

Disassemble the high pressure pipe assembly and return tube assembly.



Loosen the nut of the clamp plate of the injector.



Remove the clamp plate and the injector.

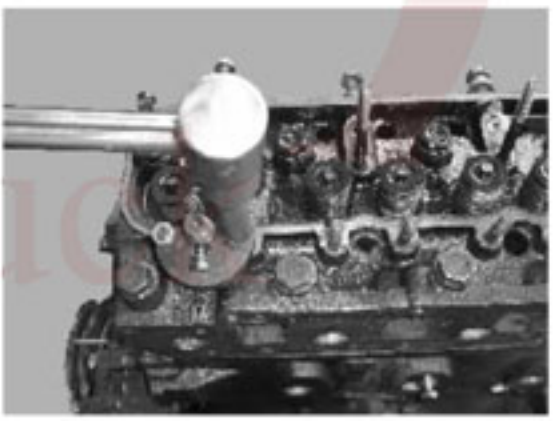


□ Installation

Put the fuel injector in the cylinder cover, and then install the clamp plate and its bolts.

Note: the locating pin on the top of the fuel injector must be placed into the retaining slot of the clam plate.

Tighten the nut of the clamp plate of the fuel injector.



Measure the distance from the top of the nozzle to the bottom plane of cylinder cover.



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(5)Injection pump

1) Explanations

□ The injection pump is used for increasing pressure for the fuel. And the high pressure fuel should be piped to fuel injector with high pressure pipe in fixed time and amount based on the different work conditions of diesel engine.

□ The used injection pump is in-line plunger pump, which constitute injection pump assembly by connecting with speed governor and fuel feed pump.

2) Replacement and repairing

□ Disassembling

Previous works: disassemble the high pressure pipe.

Remove the connecting bolts for the low pressure pipe; supercharge boost compensator pipe and lubricating oil pipe with injection pump.

Remove the connection of the acceleration cable and the fuel cut solenoid valve

Remove the front plate of the gear chamber cover.

Remove the auxiliary support bolt of the injection pump.



Remove the holding screw cap of injection pump and advance port.

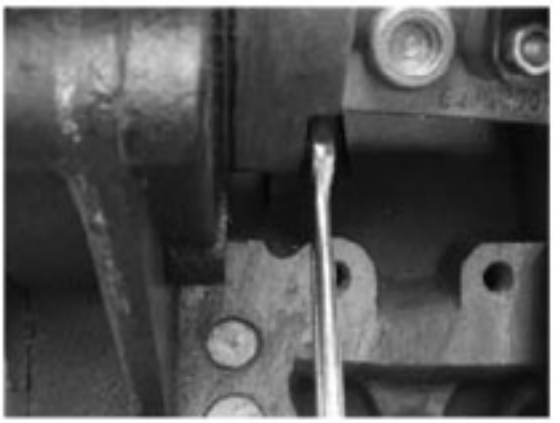


Remove the bolt outside of the spacer flange of the injection pump.

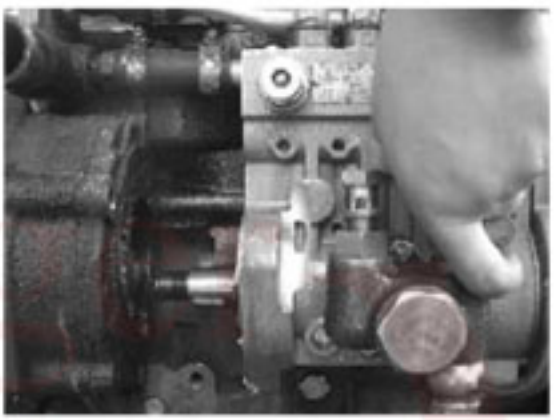


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Remove the two bolts below the inside of the spacer flange of the injection pump.



Remove the pump.



□ Installation

Turn the flywheel to the 8 degrees of crankshaft corner prior to dead-center of compression of the first cylinder counterclockwise direction (face to the flywheel). The indicator on the gear chamber cover points the 8 degrees position of the crankshaft pulley.



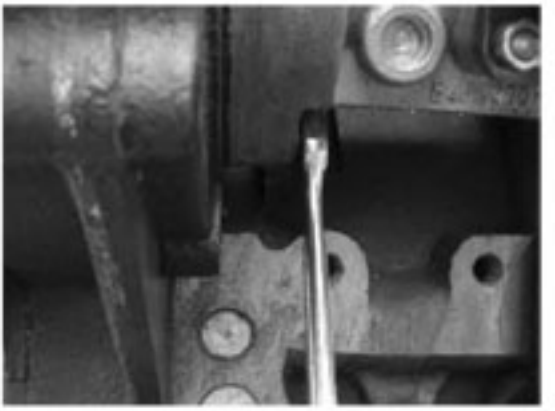
Wash the oil pump and the fitting surface of the pump joint block of the gear chamber, and then install the oil pump into the gear chamber.

Tighten the bolt outside of the oil pump.



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Tighten the bolt inside and underside of the oil pump.



Tighten the auxiliary support bolt of the injection pump.

Install the parts of the advance device, and then tighten the screw cap.



Clean the fitting surface of the front cover, and then tighten the front cover.

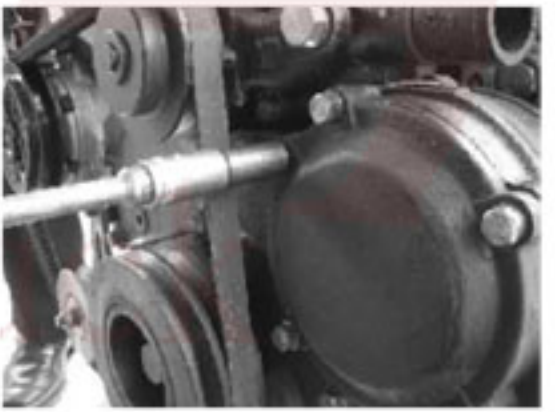
Follow-up work:

Tighten the bolts for the low pressure fuel pipe; supercharge boost compensator pipe, and lubricating oil pipe.

Install the high pressure pipe (loosen the first cylinder)

Install the connection of the acceleration cable and the fuel cut solenoid valve

Install the parts which have been removed.



□ Exhaust the air in the fuel system.

Loosen the vent bolt of the injection pump.



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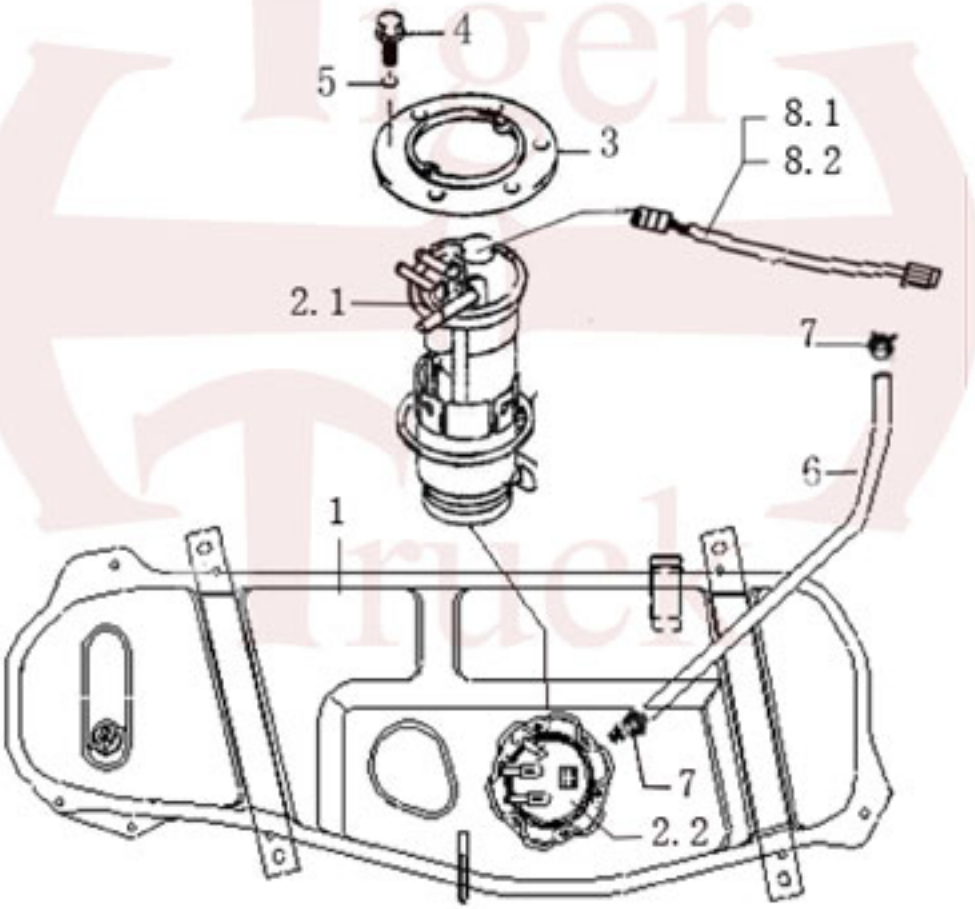
Press the handle of the feed pump repeatedly, until the diesel oil which flowed from the vent bolt free from bubbles.



1.2.1.2 JL465Q5, 474Q

(1)Structure of the Fuel System

The main parts of the fuel system are fuel tank and fuel pump assembly (including fuel filter, fuel level gauge, and shutoff valve for fuel), fuel feed pipe, return tube, and fuel steam tube (Figure 1.2-2)



1. Fuel tank assembly, 2. Electron fuel pump assembly, 3. Flanges, fuel feed pump, 4.Bolt, 5.Washer, 6.Fuel tank breather tube, 7.Metal strip resilient hoop, 8.Pump harness assembly

Figure 1.2-2

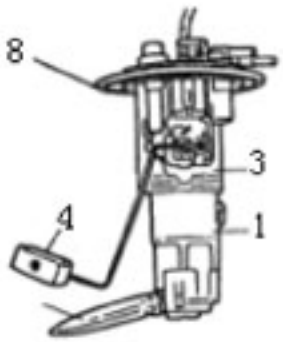
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1) Fuel Tank

The fuel tank is fixed in the lower position on the right of the automobile. The fuel pump assembly is installed in the fuel tank.

2) Fuel pump assembly

The fuel pump assembly consists of pump, fuel filter, oil level sensor, and shutoff valve for fuel.



□ Fuel pump

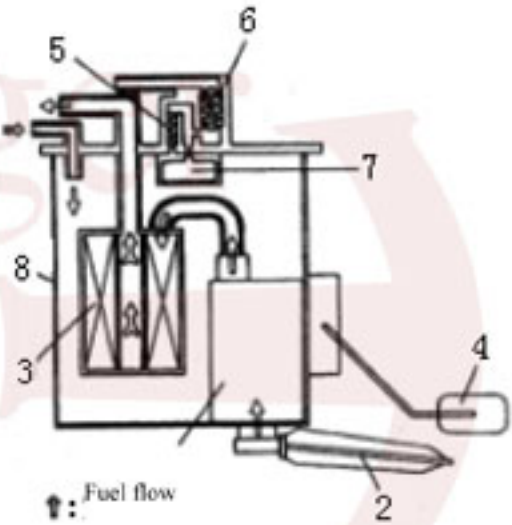
The motor of the pump assembly makes the impeller rotating when the current for pump is switched on. Because of many slots around the impeller, differential pressure occurs on the two sides of the impeller when the impeller rotating. The fuel is extracted through the inlet, and discharged through the outlet along with the pump pressure rising.

□ Shutoff valve for fuel

The shutoff valve for fuel consists of a float and a spring. Only the fuel steam is allowed to enter into the carbon canister, the fuel liquid is not allowed to flow into.

□ Tank pressure control valve (release valve and bidirectional valve)

The tank pressure control valve is used for keeping the internal pressure of the tank invariable to prevent the fuel oil flowed out and the fuel tank distorted. Release valve is used for preventing output pressure in the fuel tank raised too high; the bidirectional valve is used for protecting the pressure in the fuel tank (oil level to be invariable) to make the fuel did not to flow out or the fuel tank free from distortion.

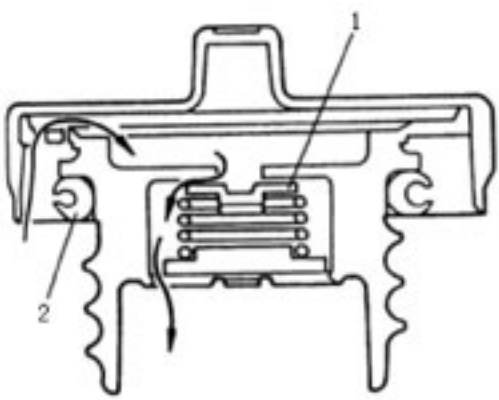


1- Fuel pump
2- Fuel inlet port
3- Fuel filter
4- Fuel level sensor
5-Release valve
6-Bidirectional valve
7-Fuel shutoff valve
8-Fuel pump assembly

3) Filling oil cover

There is a vacuum cover for the filling neck.

In order to install the cover correctly, the ratchet screwing device should be mounted on the thread filler cap to prevent the fuel oil steam be sealed bind. After the washer of filler cap contacted with filling neck flange,



1-Vacuum release valve 2-Liner

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the ratchet clatters to indicate it to be sealed into position.

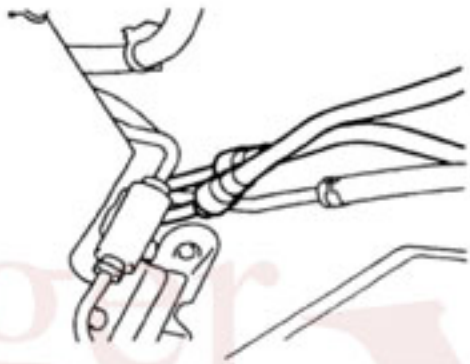
The vacuum release valve is mounted inside of this cover.

If the vapor pressure in fuel tank is too high, the vacuum release valve can open to release pressure automatically.

(2)Maintenance and Inspection

1) Fuel line

Because the fuel feed line is under the high pressure, it must be careful specially when maintaining. Inspect with naked eye, whether the fuel line leaks obviously, and whether the hose is burst and aging or be damaged. Guarantee the all tube clamps be tightened. Replace it if necessary.



2) Fuel pipe

□ Disassembling

Take off the filler cap, then release the oil pressure in the fuel feed line, and then cover it.

Detach the negative electric wires of the storage battery.

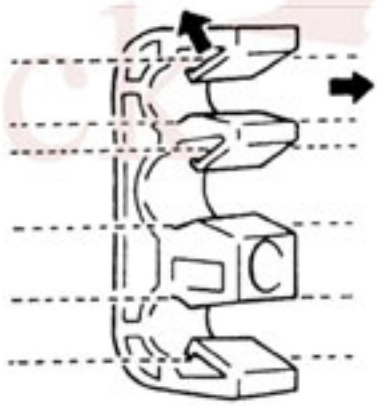
Detach the inlet tube of the engine.

Remove the fuel tube and connection on the two sides of the metal fuel line and return line.

Mark the position for pipe clamp on the fuel pipe so as to install the pipe clamps;

Remove the pipes with pipe clamps from the automobile.

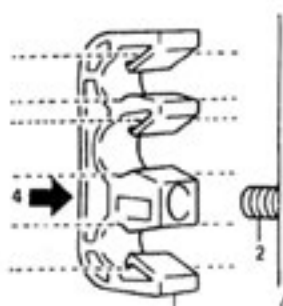
Remove the pipe clamps from the pipes.



□ Installation

Mount the new clamps to the marked position of the pipe; and then install the pipe with clamps on the automobile.

Connect the fuel hose with the pipe.



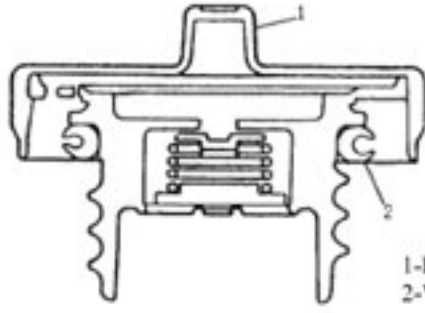
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Install the inlet tube for engine, and then fix the tube clip to make the tube firmly.

Shut off the engine, and engage the ignition switch repeatedly to check that if the line is leaked.

3) Filler cap

Take apart and check that if the filling neck is sealed by the washer and if it is aged or damaged. Replace the filler cap if there is any abnormal condition to the washer.



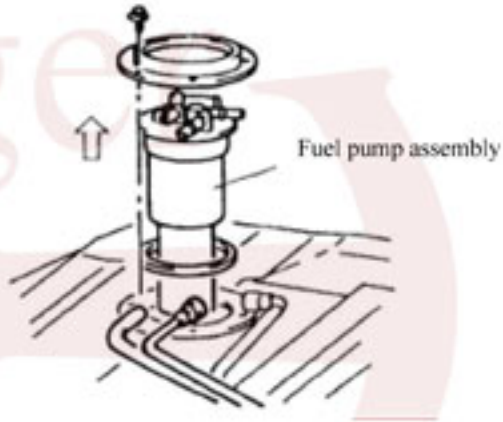
1-Filler cap
2-Washer

4) Fuel pump assembly

□ Disassembling

Take the fuel tank off from the automobile.

Remove the pump assembly from the fuel tank.



□ Inspection

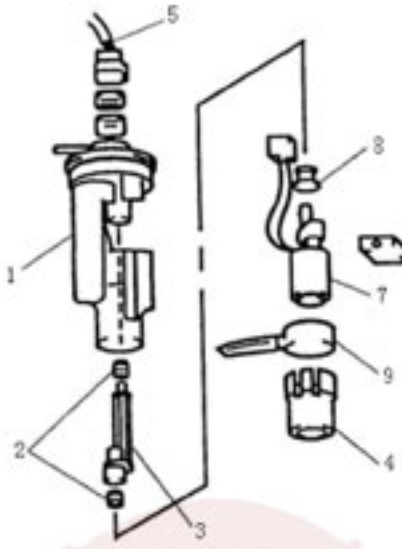
Check that if the pump assembly is damaged.

Check that if the fuel inlet port filter has any explicit rubbish and impurities, if any, replace or clean it, and check that if there is any rubbish in fuel tank;

Check the oil level gauge.

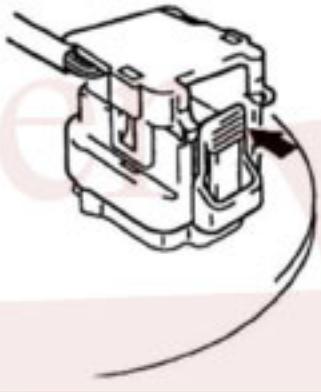
□ Dismounting

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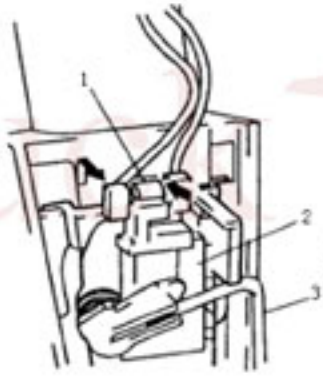
1-Pump body (including fuel filter)
2-Bushing
3-Connection
4-Erection support of pump
5-Wire
6-Oil level gauge (oil sensor)
7-Fuel pump
8-Lantern ring
9-Inlet port filter

Remove the pump/fuel gauge wire adapter from the pump body.



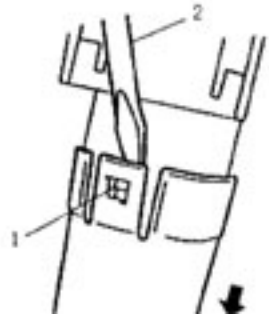
Remove the fuel gauge wire adapter from the pump body.

Press the clip-on connector, then slide the connecting piece out according to the arrow direction, and then take the oil gauge (pressure sensor) off.



1-Clip-on connector
2-Resistance board
3-Float arm

Open the long buckle with screwdriver, and then take off the erection support fixed under the fuel pump.



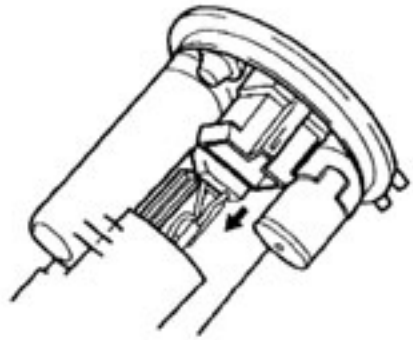
1-Clip-on connector
2-Screwdriver
3-Erection support of fuel pump

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Remove the pump wire adapter from the pump body.

Remove the pump with wire, connection and bushing from the pump body.

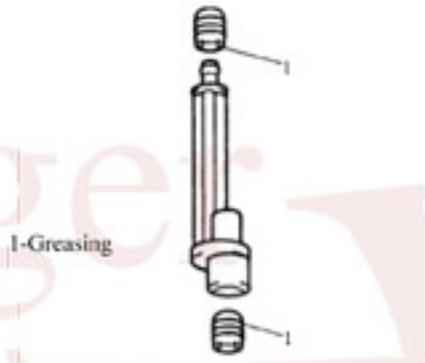
Remove the connection and / or bushing if necessary.



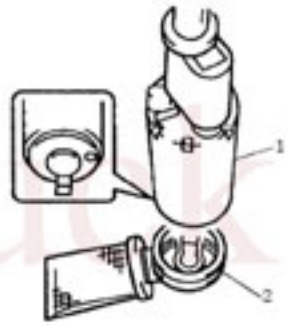
□ Assembling

Assemble the wire, lantern ring and new bushing on the pump. Check that if there is any exogenous impurity between the bushing and pump.

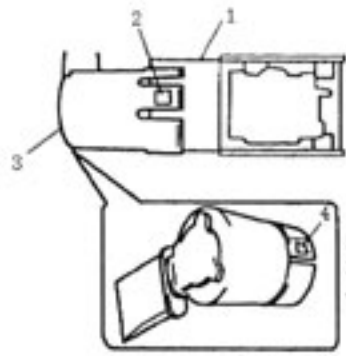
Grease the engine oil for bushing and then install the connection. Inspect that if there is any exogenous impurity between the bushing and connection.



Mount the pump support for inlet port filter on the pump.



1-Fuel pump
2-Inlet port filter

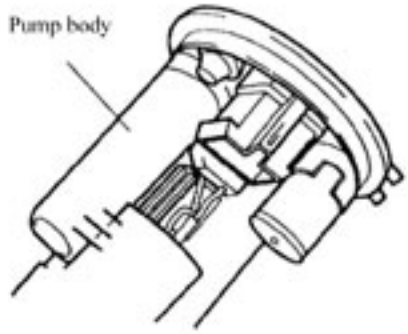


1-Pump body
2-Lug
3-Erection support of pump body
4-Window

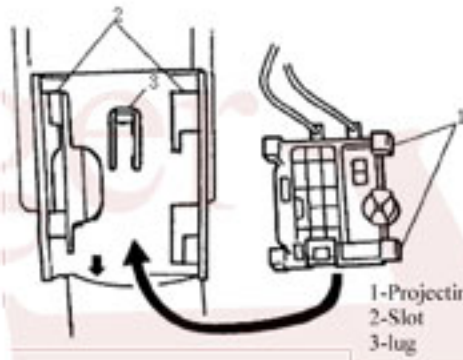
Mount the pump body to the pump assembly; erection support window is mounted firmly. exogenous impurity between the bushing and t

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Connect the wire connection of fuel pump to the pump body; And then check that if this wire is tied.



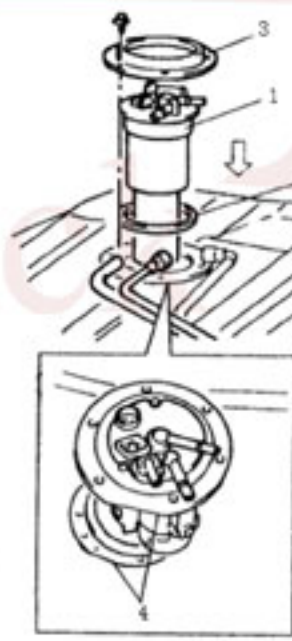
Install the oil level gauge to the pump body. Mount the projecting portion of the oil level gauge into the slot of the pump body and slip it down to the lug, and then fix the oil level gauge firmly.



1-Projecting portion
2-Slot
3-lug

□ Installation

Clean the junction surface of the fuel pump assembly and the fuel tank. Install the new washer and the Covering plate on the fuel pump assembly, and then install the pump assembly into the fuel tank.

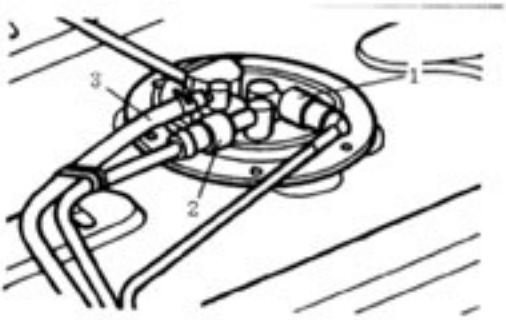


1-Fuel pump assembly
2-Washer
3-Covering plate
4-Section

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Install the fuel breather hose, steam hose, and connection to the pump assembly.

Install the fuel tank on the automobile.



1-Fuel return hose 2-Fuel feed hose
3-Fuel steam hose

1.2.2 Fault Diagnosis

1.2.2.1 Fault diagnosis for diesel engine

Problem	Analysis of cause	Processing method
Engine starts difficulty	• Empty fuel tank • Air enter into fuel system • Clogging of fuel line • No supply or supply on and off of fuel feed pump • Clogging of fuel filter • Fuel is polluted • No injection, few injection or under atomization of the injector • Undesirable installtion of fuel pump • Fuel pump failure	Fill the tank Exhaust Wash Repair or replace Wash or replace replace Adjust Adjust Repair or replace
Engine stops by itself	• Fuel is polluted • Air enter into fuel pump • Fuel line is clogged • Fuel filter is clogged • Leakage of high pressure pipe • Fuel feed pump failure • Clogging or failure of nozzle	Replace Check and exhaust Wash Wash or replace Replace Repair or replace Replace
Underpower of Engine	• Inferior quality of fuel • Clogging of fuel line • Clogging of fuel filter • Fuel feed pump failure • Incorrect established angle of injection pump • Under atomization or low pressure of injector • Insufficient supply of fuel pump	Replace Repair or replace Wash or replace Repair or replace Adjust Adjust Check, repair or replace
Used fuel is a large amount.	• Leakage of fuel system • Incorrect advance angle of injection pump • Incorrect adjustment of injection pump	Check and repair Adjust Adjust Check, repair or replace

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	• Injector failure	
Engine exhausts anomally	Black smoke • Air enter into fuel system • Incorrect established angle of injection pump • Insufficient injection or low pressure of injector • Joint of connection pipe of pressure pipe and injector unsealed White smoke • Under atomization, oil dripping, and low pressure of the injector • Incorrect established angle of injection pump • Much moisture in fuel	 Check and exhaust Adjust Adjust Reinstall Adjust, repair or replace parts Adjust Replace fuel

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1.2.2.2 Fault diagnosis for petrol engine

Problem	Analysis of cause	Processing method
Engine can not start	• Empty petrol tank • No work of electric fuel pump • No work of injector • Low fuel pressure • Leakage of injector • Injection control system failure	Fill the tank Check and repair Check and remedy fault Check and remedy fault Check and repair Check and repair, replace if necessary
Engine starts difficulty	• Low fuel pressure • Clogging of fuel line • Cold started injector does not work (cold start difficulty) or cold started injector always works (warm start difficulty) • Injector failure • Computor failure	Check and remedy fault Clean Repair Repair or replace Replace
Undesirable idle speed	• Low oil channel pressure • Under atomization, leakage or clogging of injector	Check and remedy fault Repair or replace
Undesirable acceleration	• Low fuel pressure • Undesirable work of injector	Check and remedy fault Check and remedy fault
Insufficient power	• Low fuel pressure • Clogging or under atomization of injector	Check and remedy fault Repair or replace
Over petrol consumption	• Leakage of tank • Leakage of feed line • High fuel pressure • Leakage of injector	Repair Check and remedy fault Check and adjust Repair or replace
Pant and tremble of engine	Low pressure of injector • Leakage of feed line • Clogging of fuel filter or feed line • Undesirable work of fuel pump or clogging of filter screen • Undesirable fuel pressure regulator Undesdirable injector • Clogging of injector • Leakage of series resistance • Desirable drive circuit of injector Desirable control signal of injector • Desirable air flow meter • Desirable water temperature and atmosphere temperature sensors • Desirable sensor in throttle position • ECU failure	 Check and repair Clean and replace Repair or replace Repair or replace Clean and replace Replace Replace Replace Replace Replace Replace

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1.3 Lubrication System

1.3.1 Lubrication system of gasoline engine

1.3.1.1 Structure of lubrication system

(1) Diagram of lubrication system

The lubrication system for SC1021 series vehicle engine adopts the lubrication system combined with pressure lubrication and splash lubrication. Refer to figure 1.3-1 for the pressure lubrication system.

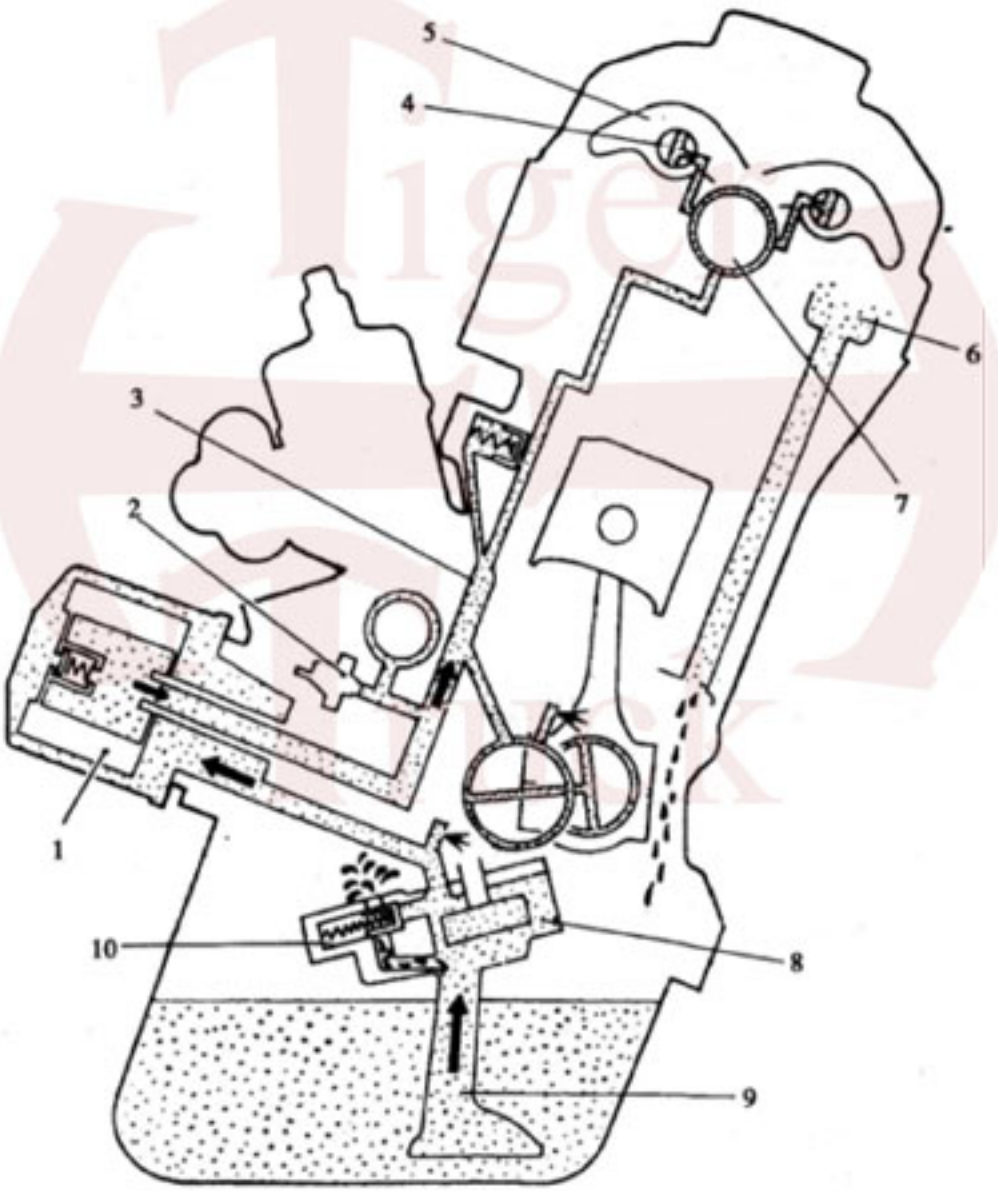


Figure 1.3-1 Diagram of lubrication system

1 - Oil filter, 2 – Oil pressure switch, 3 – Oil passage, 4 – Rocker-arm shaft, 5 – Rocker arm, 6 – Oil return passage, 7 – Cam shaft, 8 – Oil pump, 9 – Oil strainer

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(2) Oil way

The lubrication oil is lifted by oil pump and discharged by oil strainer. Based on the above way, the oil passes through the oil strainer. The oil that passes through the oil strainer goes into 2 oil passages in the cylinder. One passage is connected to the main neck bearing of crankshaft and the big-end bearing and the other is connected to central neck bearing of camshaft and rocker-arm shaft.

1.3.1.2 Maintenance of lubrication system

(1) Oil sump and oil strainer

(1) Structure of oil sump and oil strainer (figure 1.3-2)

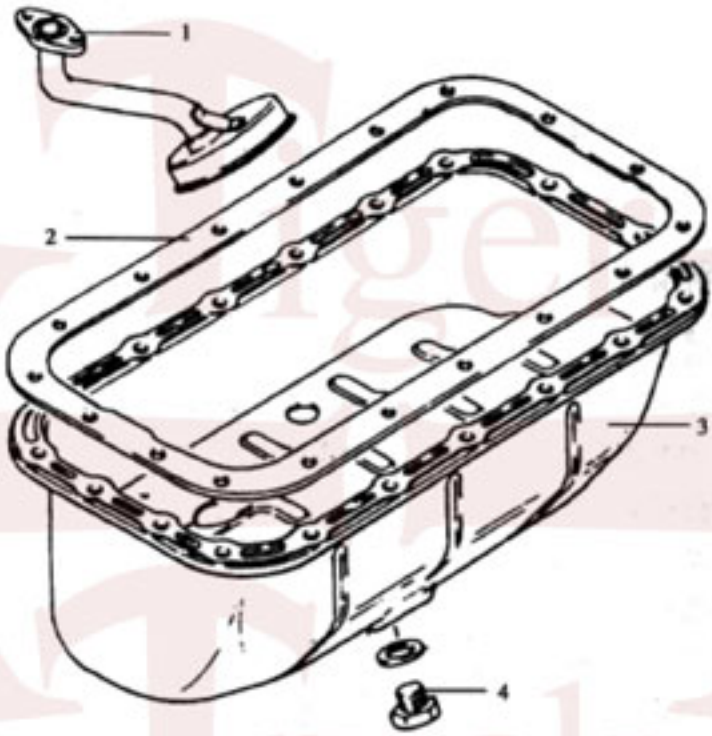


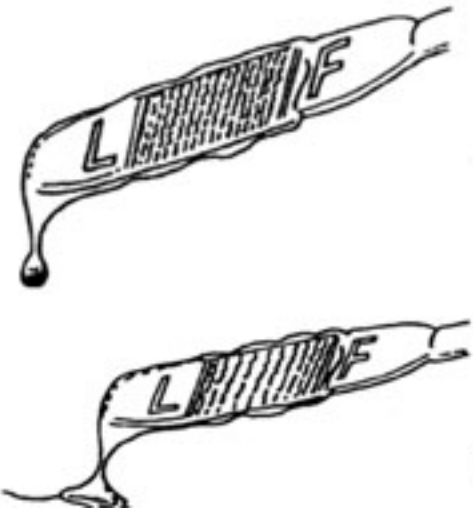
Figure 1.3-2 Oil sump and oil strainer

1 - Oil strainer, 2 - Bottom-end gasket, 3 – Oil sump, 4 – Drain plug

2) Inspection of oil sump and oil strainer

□ Inspection of oil quantity

Take off the oil level gauge rod and check the oil level after the engine stops for 15 minutes. The oil level should be located between two oil holes of gauge rod. If the oil level is close to or under the lower hole of gauge rod, oil should be added.



□ Inspection of oil quality

Check if the oil is dilute and deteriorated and impurities, such as metal scraps, are contained in the oil. If the oil is deteriorated, replace it.



□ 2) Inspection of oil sump and drain plug

Check if the oil sump and the drain plug are damaged and leak oil. If found, replace or repair them.

□ Inspection of oil strainer

Check the screen of oil strainer and corrugated gasket. If some dirt is found on the screen, the screen should be cleaned. If the O-ring is deformed, it should be replaced.



3) Replacement of oil

The engine-oil should be replaced as per log or service time so as to ensure well lubrication of the engine.

(2) Oil filter

1) Structure of oil filter

The structure of oil filter is shown as follows (felt folding structure) (figure 1.3-3).

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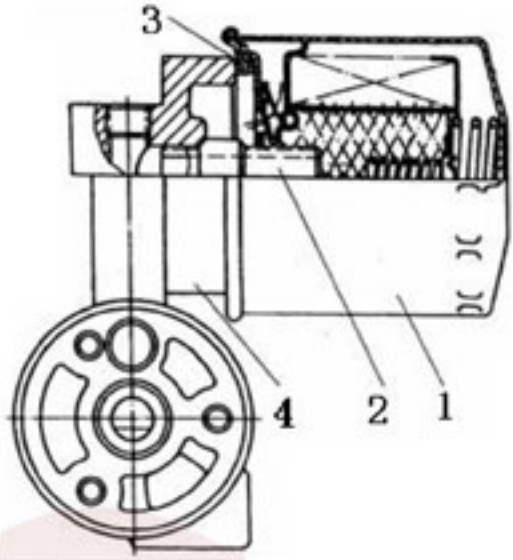


Figure 1.3-3 oil filter

1 – Oil filter assembly, 2 – Installation joint, 3 – Seal ring, 4 – Bracket assembly

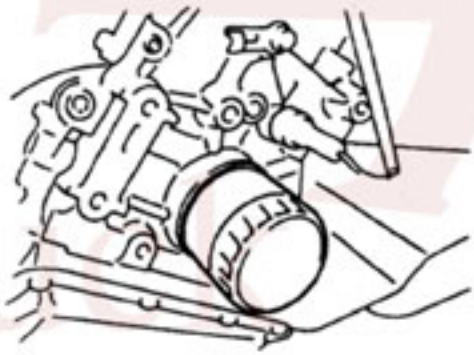
2) Replacement cycle of oil filter

The replacement cycle of oil filter: If a vehicle is new or a engine has been heavily repaired, a engine has been operated 25h or a vehicle runs 1000km, the oil filter should be replaced and after every 10000km, the oil filter should also be replaced.

3) Replacement of oil filter

□ (2) Remove the oil filter.

Take off the oil filter from the engine with spanner.



□ Cleaning the installation bracket of oil filter

Eliminate oil stains on the installation bracket with dry and clean cotton or cleaning cloth and apply little oil on it.



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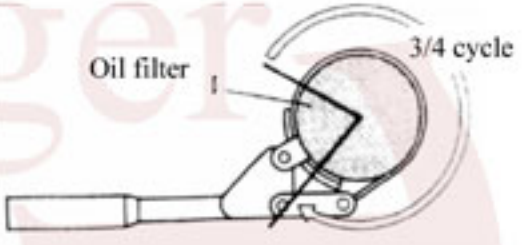
□ Treatment prior to assembly of oil filter

Immerse the oil filter in oil for 5 minutes, mount O-ring and apply oil to the junction plane before installing a new oil filter.



□ Installation of oil filter

Fix the oil filter to the installation bracket by hands and turn the 3/4 cycle from the point where it contacts with the installation surface by using spanner for oil filter.



Warning: Ensure the oil filter is screwed down, but it should not be over screwed in order to avoid oil leakage of the oil filter. Start the engine, check if it leaks oil.

(3) Oil pump

1) Subassembly of oil pump

The oil pump is the internal gearing and eccentric pump and its structure is shown in figure 1.3-4.

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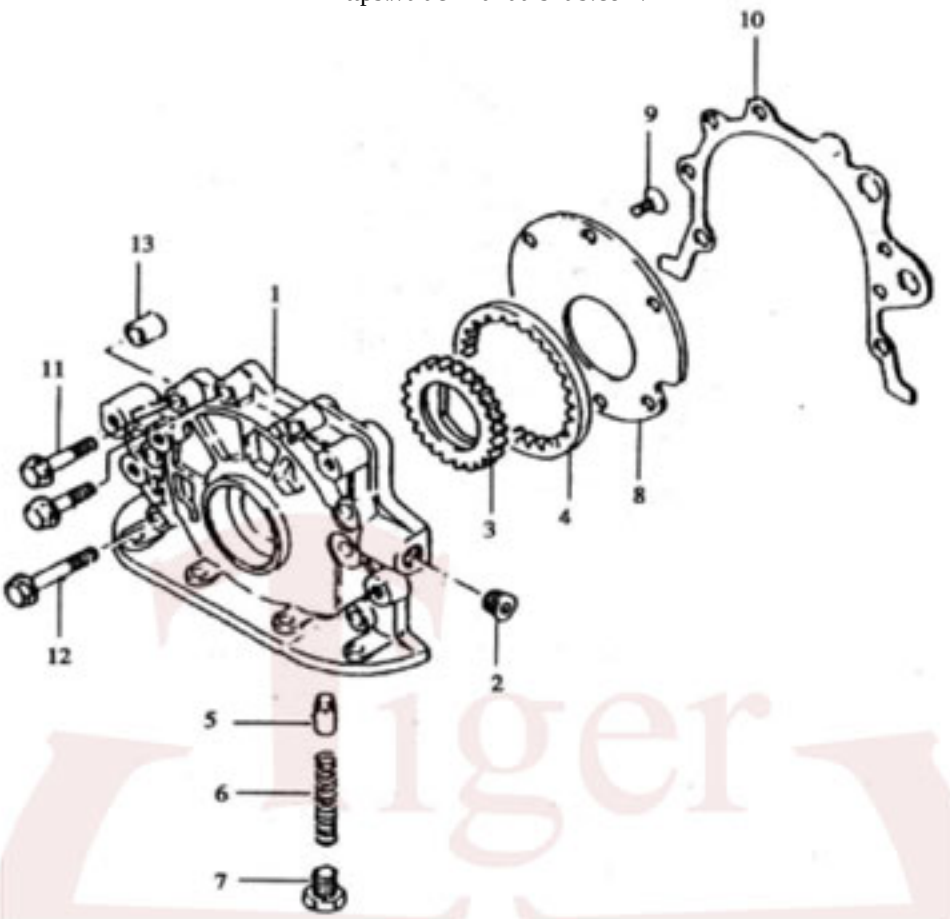
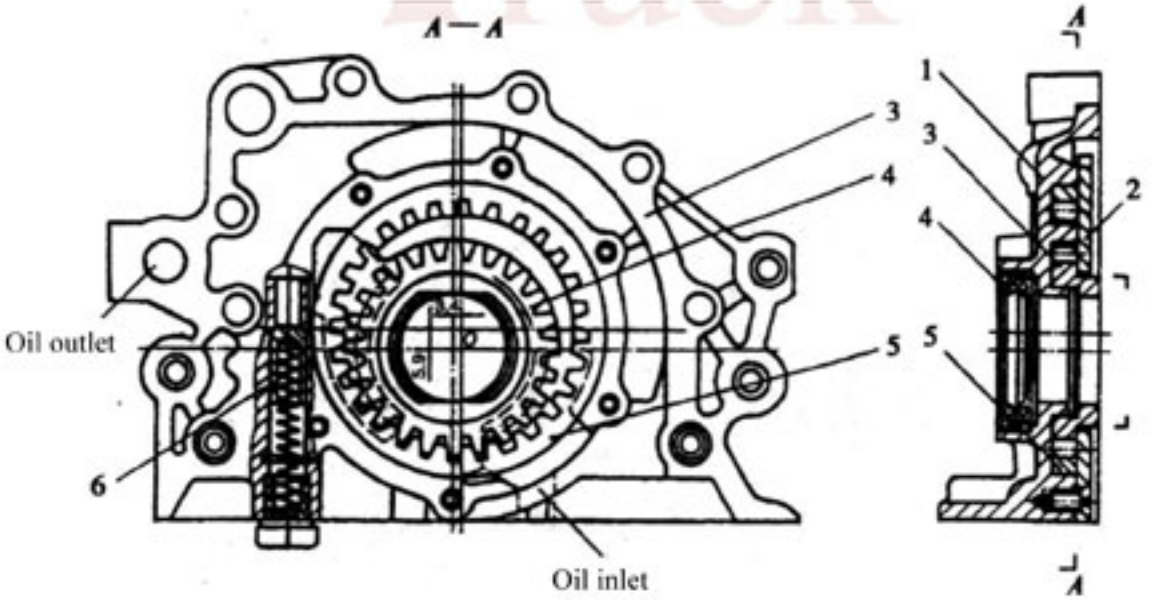


Figure 1.3-3 Subassembly of oil pump

1 – Pump body, 2 – Tapered plug, 3 – Internal gear ring , 4 – External gear ring , 5 – Limiting pressure valve, 6 – Pressure spring, 7 – Plug, 8 – Pump cover, 9 – Screw, 10 – Gasket of oil pump, 11 – Bolt, 12 – Bolt, 13 - Alignment pin

2) Structure of oil pump

The structure of oil pump is shown in figure 1.3-4.



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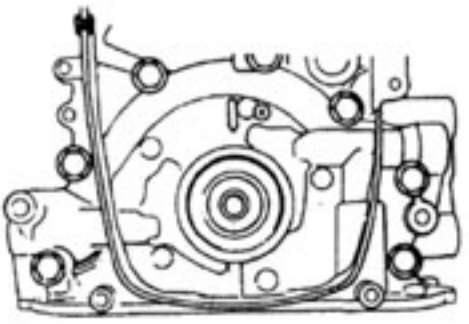
Figure 1.3-4 Structure of oil pump

1 – Pump body, 2 – Pump cover, 3 – Inner gear, 4 – Oil seal, 5 – External gear ring 6 – Limiting pressure valve

3) Disassembly of oil pump

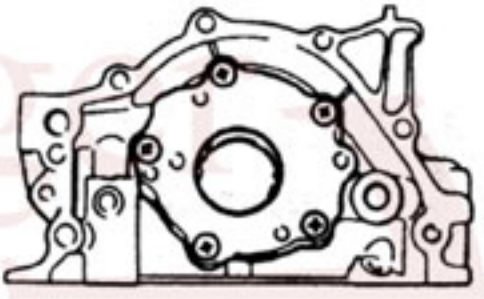
□ Disassembly of oil pump cover

Remove tightening bolts of end cover of oil pump and take off the end cover.



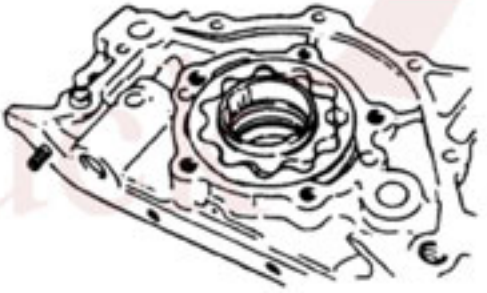
□ Disassembly of gear cover

Remove tightening bolts of gear cover and take off the gear cover.



□ Removal of gear for oil pump

Take off gears, gear rings, crescent-shaped block and other parts from the oil pump cover.

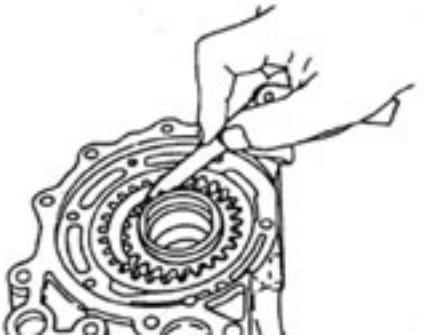


□ Cleaning parts for oil pump

Completely clean components and parts of oil pump with tune up oil.

4) Inspection of oil pump

□ Radical clearance between internal gear



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and crescent-shaped block

Measure the radical clearance between internal gear and crescent-shaped block with feeler.

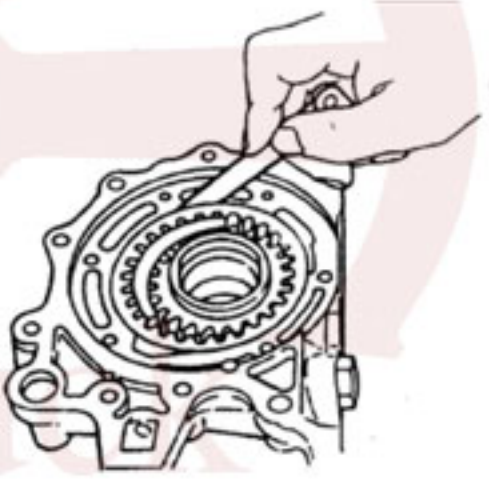
□ Radical clearance inspection between external gear and crescent-shaped block

Measure the radical clearance between external gear and crescent-shaped block with feeler.



□ Clearance inspection between external gear and pump cover

Measure the clearance between external gear and pump cover with feeler.

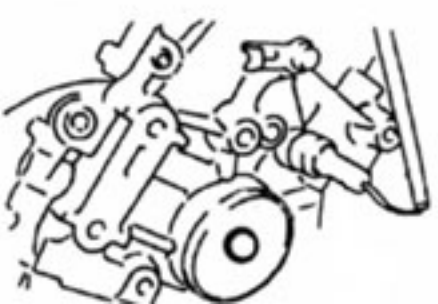


□ Inspection of lateral clearance

Measure the lateral clearance between external gear/internal gear and pump cover with feeler and straight edge ruler.

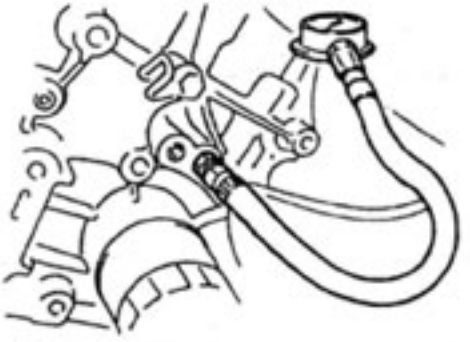
□ Inspection of oil pressure

Remove the oil pressure switch: Remove the oil pressure switch from the oil filter next to oil passage.



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Install the oil pressure gauge and check the oil pressure: Fix the oil pressure gauge to the hole for oil pressure switch, then start the engine, increase water temperature to normal temperature and check the oil pressure.



Warning: Oil quantity in the oil sump of engine must comply with specified standards during inspecting the oil pressure. If the oil level is too low, add oil to upper limit of oil level gauge. Oil specification:

5) Installation of oil pump

The installation method of oil pump is opposite to the disassembling sequence. During assembling, make sure the installation of gaskets in order to avoid oil leakage.

1.3.1 Lubrication system of diesel engine

1.3.2.1 Structure of lubrication system

The lubrication system for friction surfaces of major moving parts of diesel engine is combined with pressure and splash lubrication. Major components and parts of lubrication system include: Oil pump, oil cooler, oil filter and oil collector assembly etc.

The operating principle of lubrication system: When the oil pump is rotating, oil in the oil sump passes through the oil collection, then goes into the oil passage and goes through the oil cooler. After cooling down, it flows into the oil filter and goes into the main oil passage (figure 1.3-5). After oil goes into the main oil passage, it becomes many branches for lubricating main journals and main bearings, connecting rod journals and connecting rod bearings, journals and bearings of camshaft, rocker arms and rocker-arm shafts, gear shafts and bearings, injection pumps (through oil delivery pipe) and pistons cooled through piston cooling nozzle (figure 1.3-6, 1.3-7). With splash lubrication, gears are lubricated.

In addition, most oil that has passed through the oil filter goes into the main oil passage and small oil goes into the booster.

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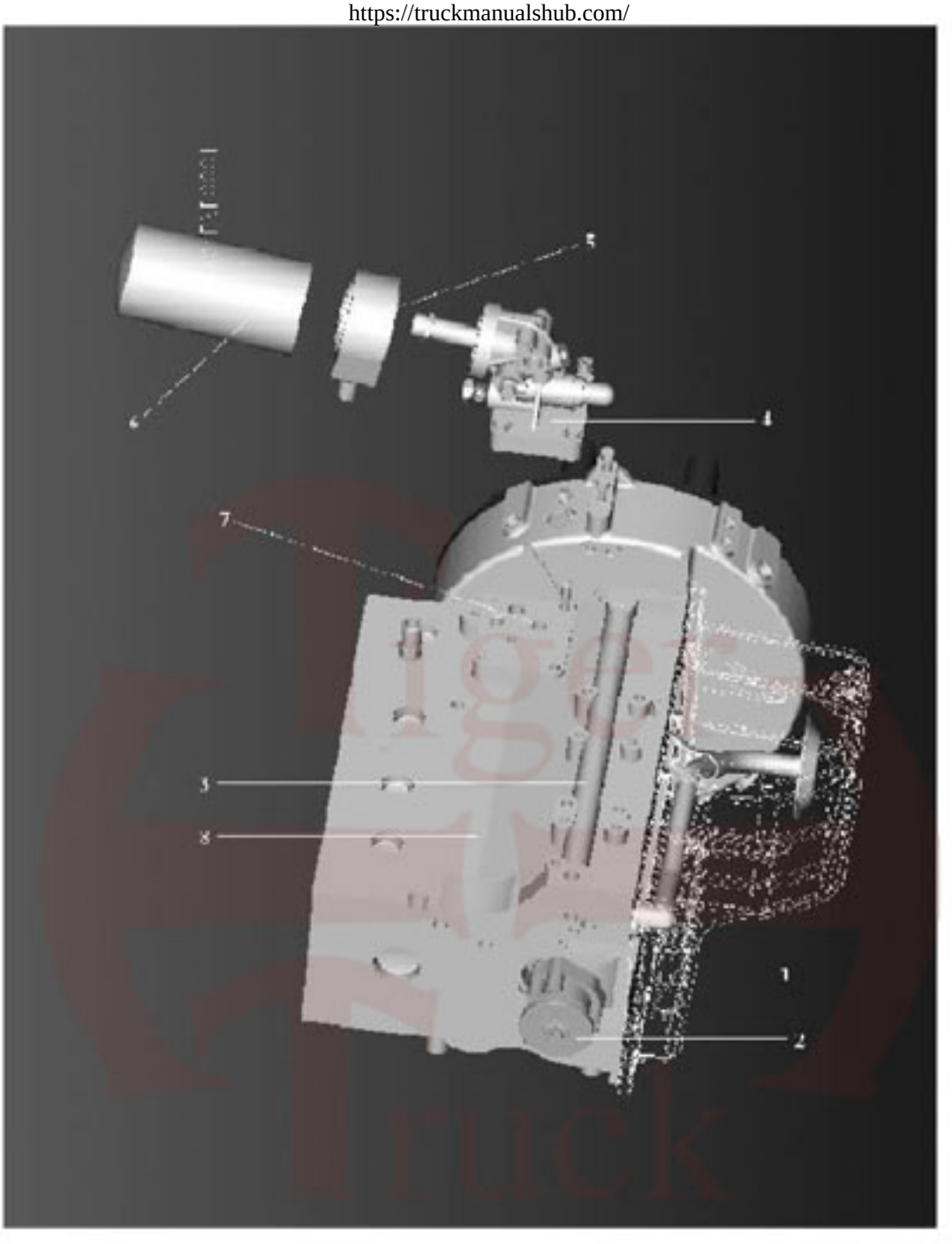


Figure 1.3-5 Oil cooler combined with oil filter

1 – Oil collecting assembly, 2 – Oil pump, 3 – Oil passage, 4 – Oil cooler seat, 5 – Oil cooler, 6 – Oil filter (with by-pass valve), 7 – Oil return hole of filter, 8 – Oil return hole

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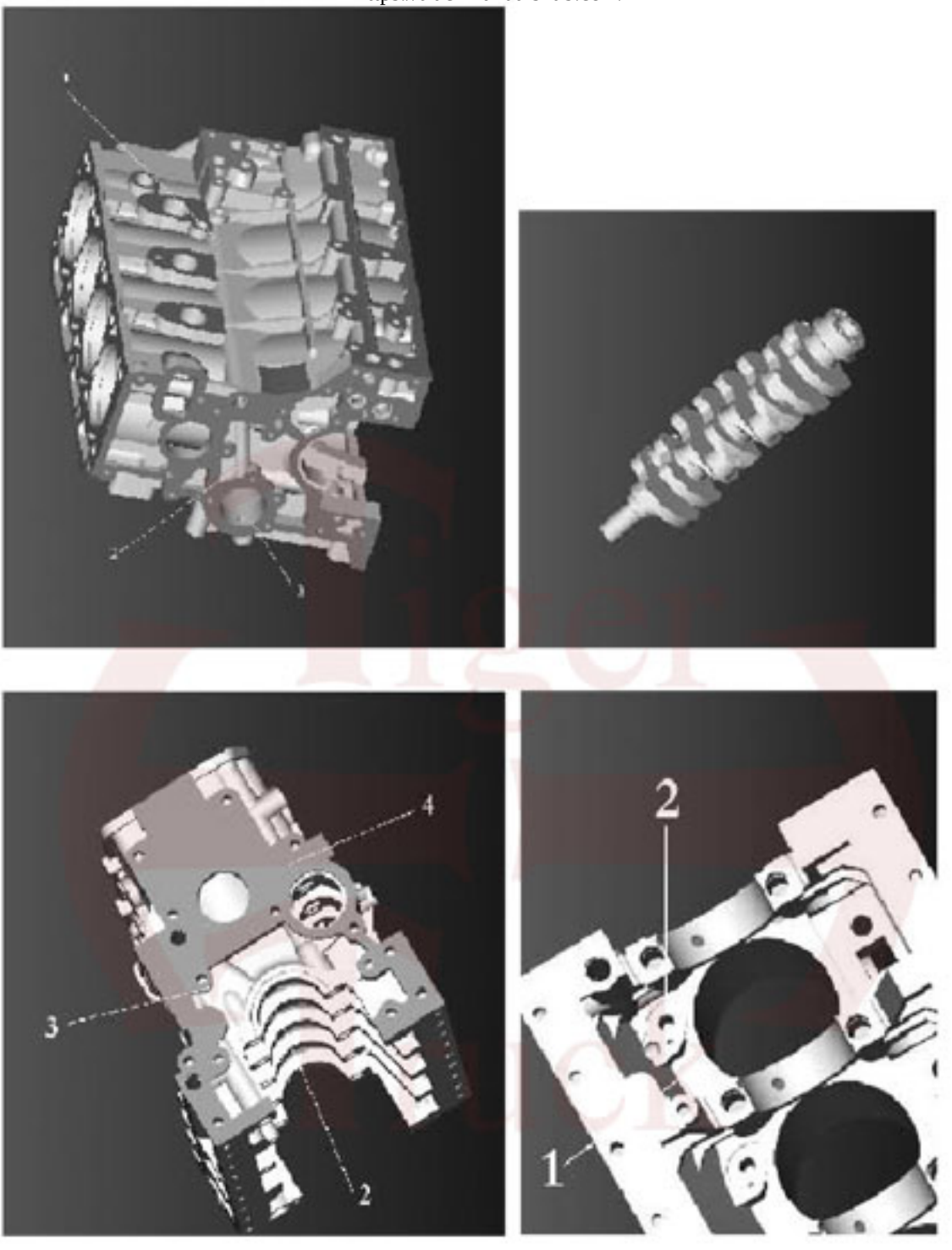


Figure 1.3-6 Lubrication of moving parts

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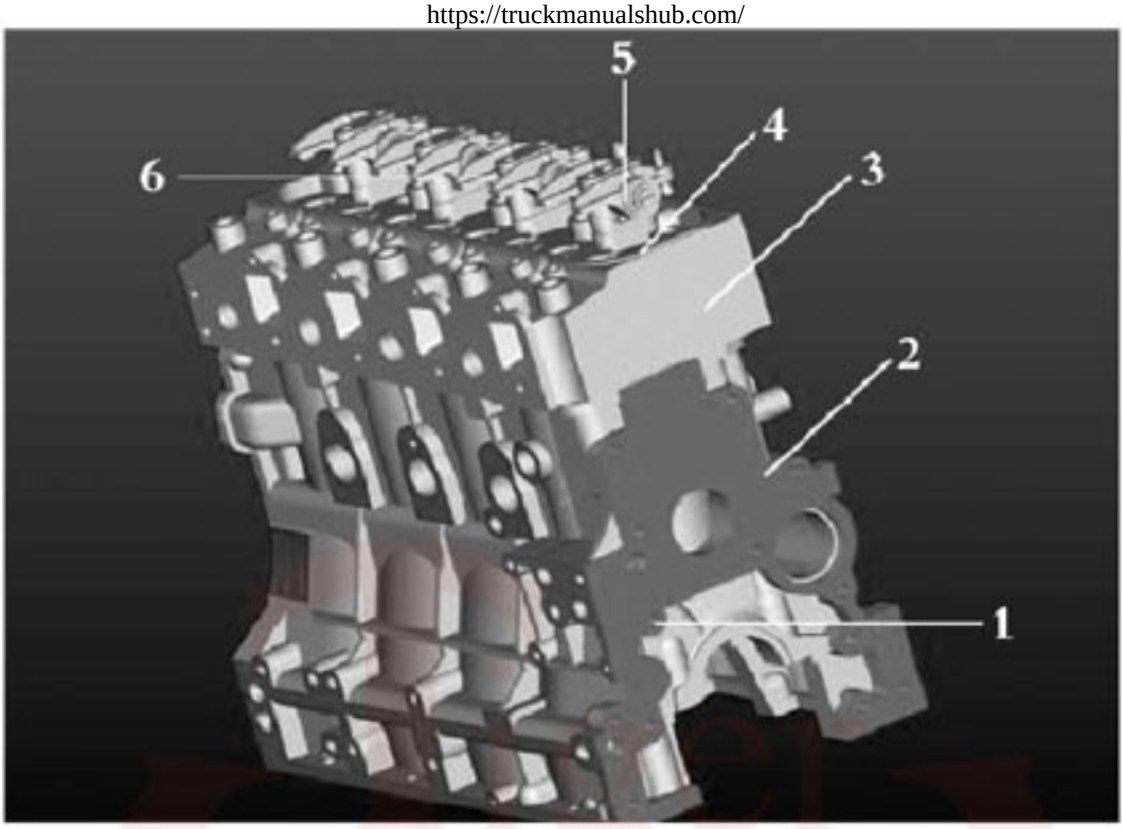


Figure 1.3-7 Lubrication of moving parts

1 – Main oil passage, 2 – Oil delivery hole to the cylinder cover, 3 – Oil delivery hole on the cylinder cover, 4 – Internal oil passage of rocker arm shaft, 5 – Rocker-arm shaft, 6- Hole on the rocker-arm shaft

1.3.2.2 Maintenance of lubrication system

(1) Oil sump, oil collector assembly

1) Description of lubrication System

□ The oil sump is used for holding oil, with the volume of 6.5L.

□ Oil collector assembly is used for taking oil from the oil sump into oil passages of block so as to lubricate each component and part of diesel engine.

(2) Replacement and service

□ Disassembly

Loosen the drain plug of oil sump and drain off oil.



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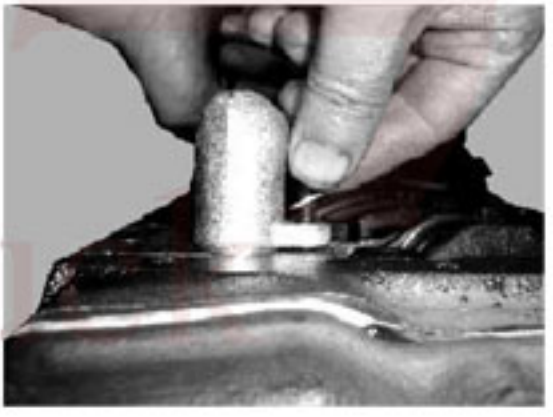
Loosen tightening bolts of oil sump and bottom surface of cylinder and remove the oil sump.



Remove the spacer for oil sump. Clean the junction plane of bottom surface of cylinder and oil sump.



Remove 3 tightening bolts between the oil collector and the body and take off the oil collector.



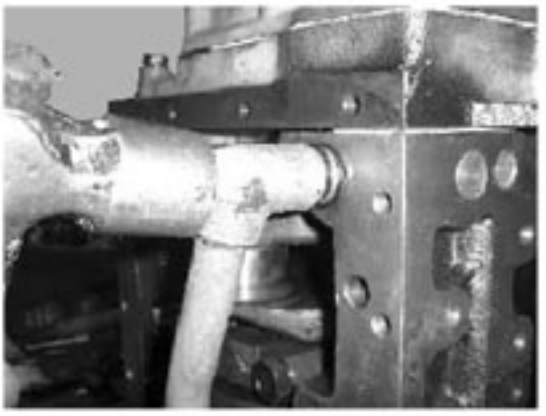
□ Installation

Install seal rings in the oil collector and apply oil.

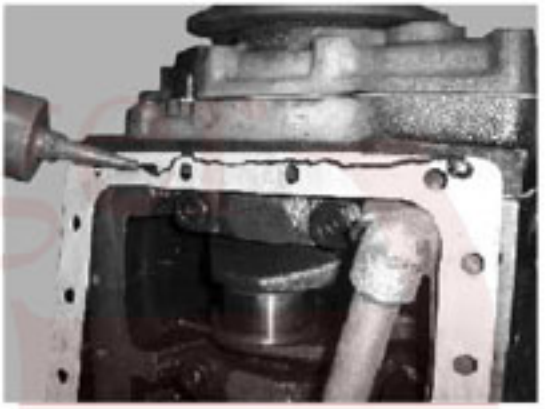


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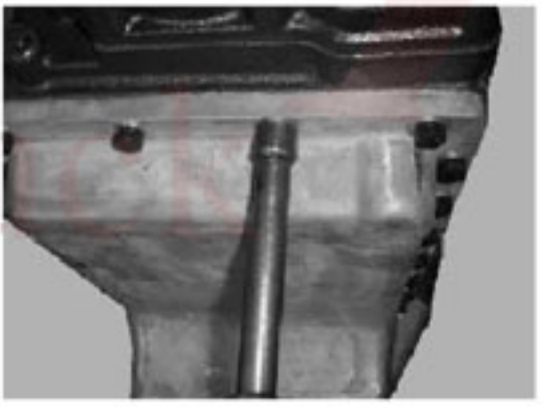
Fix the body to the oil collector and screw bolts.



Apply sealant to both surface of spacers for oil sump. Put spacers for oil sump on the bottom surface of cylinder.



Cover the oil sump and tighten bolts.



Fit over the sealing washer to the drain plug and tighten them to screw.



(2) Components of oil cooler & filter

1) Description

□ Components of oil cooler & filter cool oil with coolant liquid in order to ensure oil temperature of diesel engine is within a normal range. The filter is used for filtering impurities in oil.

□ The pressure regulator valve is used for regulating the oil pressure from cylinder oil passage and keeping it stable. The safety valve is used for ensuring that oil can bypass the filter element and go into the oil passage for oil filter and the oil supply of diesel engine does not stop when the filter element of oil filter is blocked. The filter element of oil cooler is composed of a set of cooling fins, which are used for transmitting heat to the coolant fluid.

□ The element of oil filter should be replaced when a vehicle is driven every 15,000km, or the diesel engine is operated every 300 hours or every 3 months.

□ This chapter describes how to service the pressure regulator valve, the filter element of oil cooler and oil filter in components of oil cooler & filter.

□ Components of oil cooler & filter include an oil filter, an oil cooler, an oil filter seat, an oil filter of booster, a pressure regulator valve, a safety valve (located in the oil filter), oil delivery pipes and joints.

2) Replacement and service

Preparation:

Remove inlet and return pipe of cooler;

Remove oil level gauge tube;

Oil filter



□ Disassembly

Remove the oil filter.

Remove the oil cooler and O-ring.



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Spool of pressure regulator valve and spring:

Remove the tightening nut and remove the spool and spring. Check the spool of pressure regulator valve and spring.



Oil filter seat:

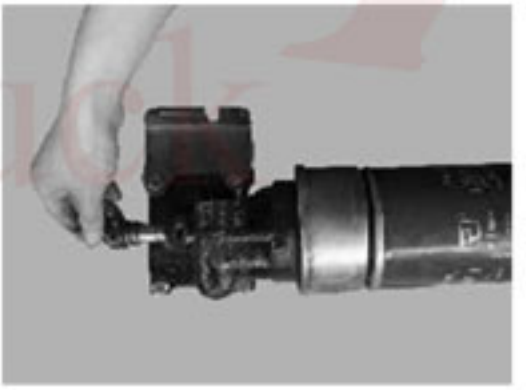
Remove 4 bolts and take off seal rings.



□ Installation

Pressure regulator valve:

Set the pressure regulator valve, spool and spring into the installation hole for pressure regulator valve. Screw up the tightening nut.



Oil filter seat:

Cleaning fitting surfaces of body and oil filter.



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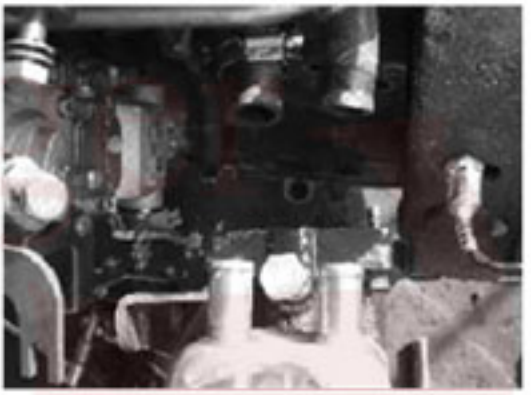
Fix O-ring to inlet and outlet holes for fitting surfaces and tighten bolts.





Oil cooler:

Fix the oil filter seat to the oil cooler and the direction or inlet/outlet holes is toward to the body direction.



Oil filter:

Fix the seal ring to the oil cooler and take the filter into the cooler. After the seal ring contacts with the fitting surface, turn 1/2 cycle.

(3) Components of oil pump

1) Description

□ The oil pump is designed to gear type, which is used for delivering oil in the oil sump to the main oil passage of cylinder at certain pressure.

□ The oil pump that is fixed to the crankshaft drives the gear. Components of the oil pump include the safety valve. Oil supply pressure for oil pump cannot exceed specified value.

2) Replacement and service

□ Disassembly

Preparation: Removing the gear cover

Measure the lateral clearance between the



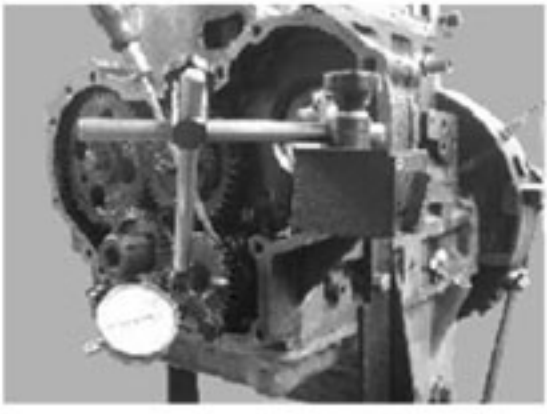
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oil pump gear and the oil pump drive gear with a dial indicator and understand the weariness of tooth face.

Specified size: 0.030 – 0.330;

Limiting size: 0.400.

Measure the axial clearance between the oil pump gear face and the cover with a dial indicator and understand the weariness of gear face and cover.



Specified size: 0.025 – 0.120;

Limiting size: 0.180.

Loosen tightening bolts of driven gear and driving gear shaft of oil pump and take off the driven gear.



Remove the hexagon head plug of safety valve for oil pump.



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Take off the spring and the spool.



Remove tightening bolts between the oil pump cover and the cylinder and take off oil pump assembly.



Check the spring and the spool.



Check the inner gearing rotor of oil pump and observe if it has been damaged.



□ Installation

Put the spool and the spring into the oil



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pump and the hole for safety valve in turn, then press the spring with the copper backing on the plug and screw up the safety valve on the oil pump.

Fix oil pump assembly; align the gear shaft and alignment pin; match the oil pump cover with the gear; fix the seal ring at oil-in/out holes and fix oil pump assembly to the cylinder with alignment pins and bolts.





Fix the driven gear to the drive gear shaft and tighten bolts.

Tightening torque: 28 – 35 N.m

Check the gear backlash between the driven gear and the oil pump drive gear,

(0.030-0.330).



Future work:

Install the gear cover,

Install other disassembled parts and components.

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1.3.3 Troubleshooting

Condition	Possible cause	Correction
Low oil pressure	• The oil pressure gauge is not correct.	Repair or replace.
	• The oil pressure sensor fails.	Repair or replace.
	• The oil viscosity is too low.	Replace.
	• The diaphragm for oil pump is broken so that fuel oil goes into oil pan or unburned gas in the combustion chamber goes in to the oil pan so that oil is diluted.	Check and repair.
	• The oil level for pan is too low.	Fill up oil.
	• The oil pump gear and the pump cover are worn or the gasket is so thick that oil for oil pump is insufficient.	Replace wearing parts.
	• The screen of oil strainer is blocked.	Clean or replace.
	• The pressure regulator valve is not correctly adjusted and closed or the spring is broken down.	Adjust, repair or replace.
	• External and internal pipes leak.	Check and repair.
	• The main bearing of crankshaft and the connecting rod bearing or camshaft are worn.	Replace wearing parts.
	• The temperature of engine is too high.	Check and service the engine.
High oil pressure	• The oil pressure gauge is not correct.	Repair or replace.
	• Oil is thickening up or the viscosity of newly-replaced oil is high.	Replace.
	• There are lots of deposits in the main oil passage and braches or the gap of main bearing of crankshaft, connecting rod bearing and camshaft bearing is small.	Clean or adjust.
	• The pressure regulator valve is not adjusted.	Adjust
Large oil consumption	• Pistons, piston rings and cylinder wall are excessively worn.	Replace.
	• Piston rings are broken down.	Replace.
	• The engine leaks oil.	Service.
Noise of oil pump	• The gear for oil pump is excessively worn.	Replace.

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1.4 Cooling System

1.4.1 Structure of cooling system

When engine cold starts (water temperature below 82℃, thermostat is in closed conditions), coolant is sent to adjacent first cylinder water jacket by water pump. At this time, coolant flows through cylinder block and cylinder head, and then flows back through intake manifold, by-pass hose and water inlet pipe. Such completing a small cycle.

When engine is in normal working temperature (water temperature above 82℃, thermostat is in open condition), coolant flows along a path basically similar to that of small cycle. But partial coolant flows back to water pump through thermostat, radiator water inlet hose, radiator, radiator water outlet hose and water inlet pipe. such completing a big cycle.

Structure of cooling system is as shown in Fig. 1.4-1.

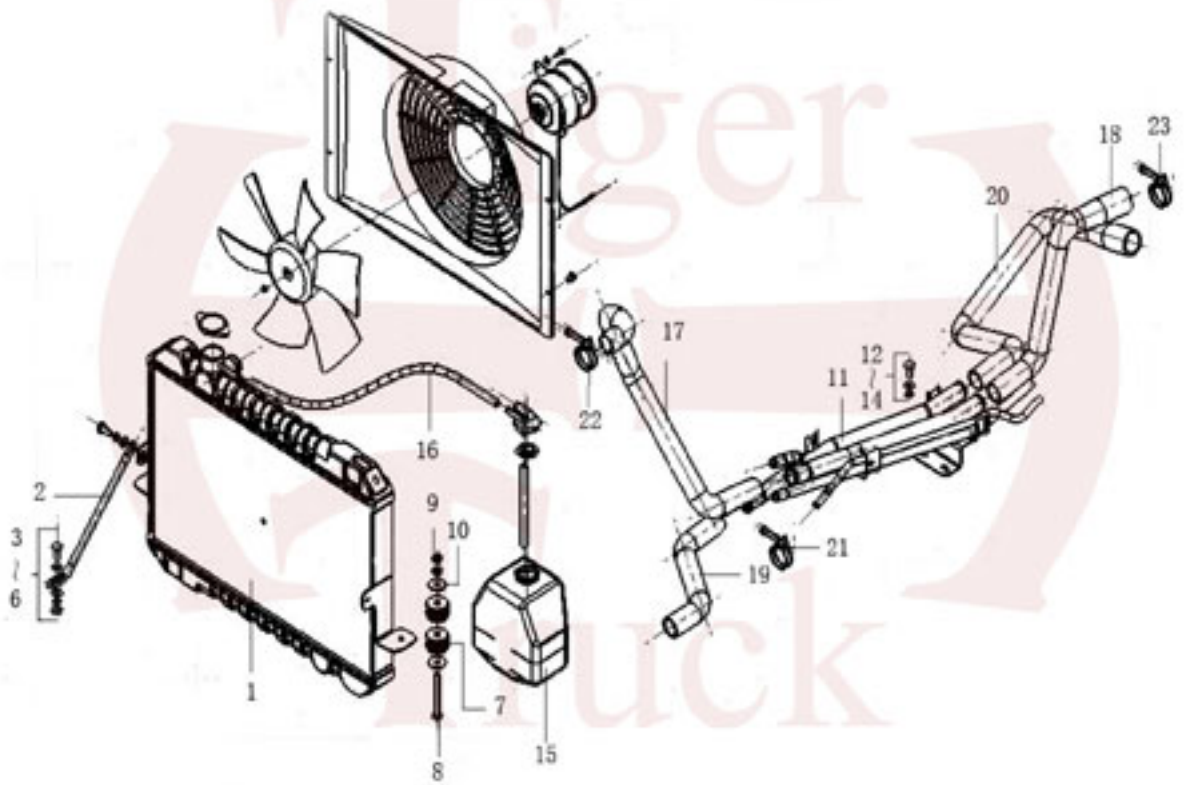


Fig. 1.4-1 Cooling System

1. radiator assembly; 2. radiator brace; 3-6. 8-12, 12-4, standard parts; 7. rubber gasket; 11. floor water pipe assembly

15. battery assembly; 16. rubber pipe; 17. upper hose (rear); 19. lower hose (front); 20. lower hose (rear)

21-23. double-wire hoop

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1.4.2 Maintenance of Cooling System

1.4.2.1 Cooling fan and water pump belt

(1)Inspection and adjustment of cooling fan and water pump belt

1) Inspection of belt

Check belt for any cracks, fracture, deformation and other wears and replace it if any.

2) Inspection of belt tension

Exert a force of some 98N (10kgf) on the middle of belt and belt tension should conform to required value. Otherwise, adjust it.

3) Inspection of belt tension

If the belt is too tight or too loose, loosen alternator adjusting bolt and pivot bolts to adjust belt to proper tension by moving alternator.



(2)Installation and adjustment of cooling fan

When cooling fan is reinstalled or replaced, pay attention to installation direction of cooling fan, tighten bolts and nuts, and adjust water pump belt tension to required value.

1.4.2.2 Radiator and compensation reservoir

(1) Structure of radiator and compensation reservoir

Structure of radiator and compensation reservoir is as shown in Fig.1.1-13.

(2)Disassembling of radiator

1) Drain coolant

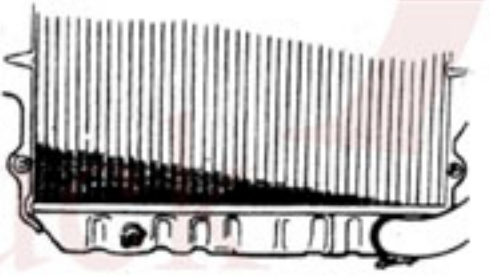
When engine is in cold state, open radiator drain cock to drain coolant completely.

2) Disassemble radiator water inlet hose

Loosen connecting hose clamp from radiator to remove water inlet hose.

3) Disassemble radiator water outlet hose

Loosen water outlet hose clamp from vehicle body bottom to remove radiator water outlet hose; remove expansion water tank inlet hose from radiator cap.



4) Disassemble radiator with electronic fan assy.

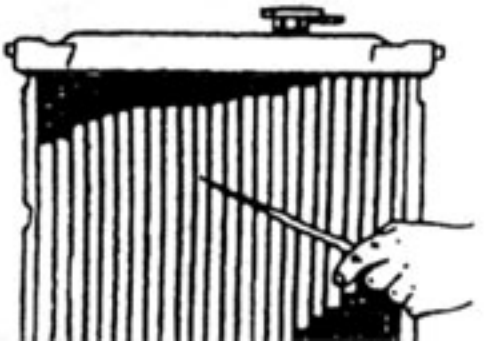
First remove fixing bolts of radiator stand and front brace, and then remove radiator with electronic fan assy.

5) Remove fan and shroud.

Remove fixing bolts of fan shroud to take away fan shroud with electronic fan assembly. Remove fixing bolts of fan and fan motor to take away fan and fan motor.

(3)Inspection of radiator and compensation reservoir

(1)Visual inspection of radiator

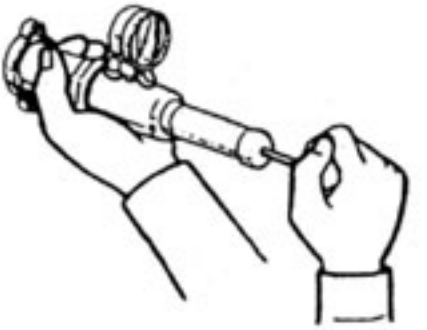


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Clean radiator, remove dust, sundries, and check radiator for any deformation, off-welding and damages; replace if any.

(2) Inspection of radiator cap

Exert a certain force. R on radiator cap to check the opening pressure of radiator cap valve; if pressure is lower than limit, replace it.



3) Inspection of radiator

Exert a certain force on radiator to check radiator for any seepage, and repair it if any.

4) Inspection of connecting hose

Check radiator connecting hose for any fractures, aging or other mechanical damages, and replace it if any.



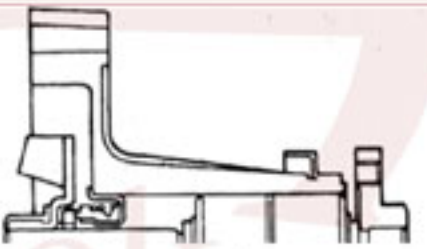
5) Inspection of compensation reservoir and rubber pipe

Check compensation reservoir and rubber pipe for any fractures, and aging, and hose connection for looseness; replace it if any.

1.4.2.3 Water pump

(1) Structure of water pump

Water pump is of centrifugal impeller pump and impeller is supported by a fully-sealed type bearing.

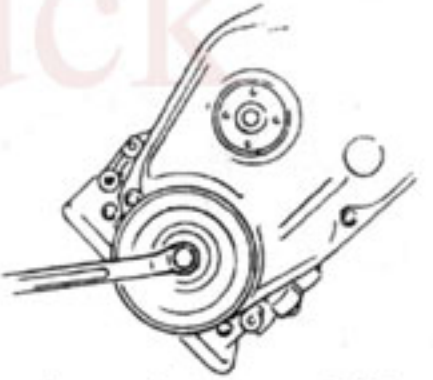


(2) Disassembling of water pump

1) Completely drain coolant before disassembling.

2) Disassemble camshaft belt pulley.

Loosen camshaft belt bolts to take away belt pulley from camshaft.



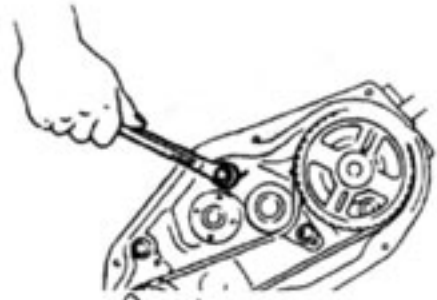
3) Disassemble timing belt case.

Loosen timing belt outer cover bolts to remove timing belt outer cover.

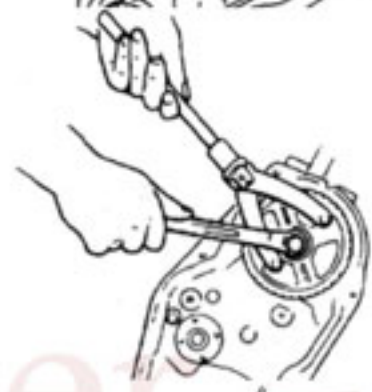


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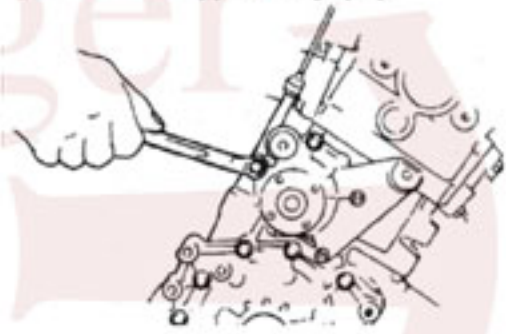
4) Remove timing belt.
Loosen timing belt tensioning bolts to remove camshaft timing belt pulley and its drive belt.



5) Remove camshaft timing belt pulley and inner cover.
Use special tools to stop camshaft timing gear, loosen fixing bolts and remove timing gear and inner cover.



6) Disassemble water pump assy.
Loosen water pump fixing bolts to remove water pump.

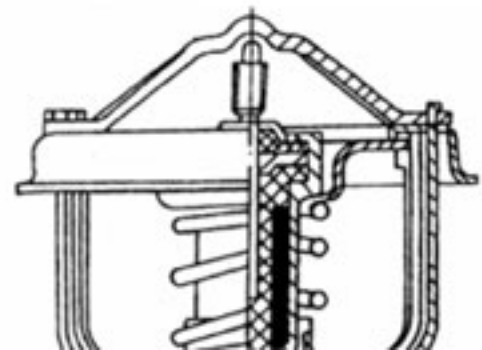


(3) Inspection of water pump
Rotate water pump by hand to check it for any obstacles and abnormal noise. If any, replace water pump assy.



(4) Installation of water pump
Water pump is installed in reverse sequence as that of disassembling. But following matters must be noticed:
1) Replacement of new water pump seal.
2) Bolts tightening torque

1.2.4.4 Thermostat
(1) Structure of thermostat



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(2) Disassembling of thermostat

1) Disassemble thermostat housing.

When engine is in cold state, loosen fixing bolts of thermostat housing to remove thermostat housing.

2) Disassemble thermostat.

Disassemble thermostat housing to take out thermostat from inside of intake manifold.



(3) Inspection of thermostat

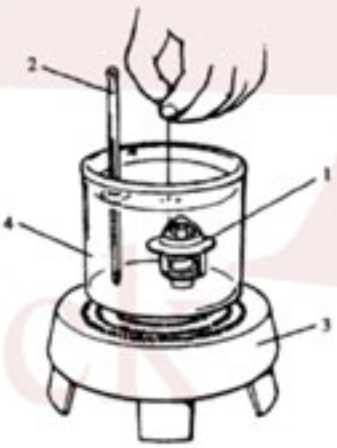
1) Cleaning of thermostat

Thermostat is of wax-type temperature sensing element. Remove water scale and dirt from thermostat surface to keep thermostat bleed valve clean, and to facilitate cooling strength adjustment of engine.



2) Inspection of thermostat

Place a beaker with water on electric heater for heating, put one end of the line into thermostat and then put thermostat into water to check the opening temperature of thermostat valve.



1. thermostat; 2. thermometer; 3. electric heater;

1.4.2.5 Inspection and change of coolant

(1) Coolant specification

Coolant of SC1021 series for truck is alcohol-type anti-freeze liquid, i.e. mixture of alcohol and water.

(2)Inspection of compensation reservoir coolant

1) Inspection of compensation reservoir guide

The distance between guide and compensation reservoir bottom should be kept at about 10mm.

2) Inspection of coolant in compensation reservoir

Coolant level in compensation reservoir should be kept between “low” and “Full” and coolant should be timely filled to “Full” if below “Low”

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1.4.3 Trouble Shooting

Trouble	Cause analysis	Method
Engine overheat	• Water pump belt loose or damaged • Coolant insufficient • Thermostat faulty • Water pump performance poor • Radiator dirty or bent • Cooling system leaky • Cooling fan motor or switch damaged • Radiator clogged • Radiator cap faulty • Ignition timing misadjusted • Brake seizure • Clutch slipping • Air resistance in cooling system	Adjust or replace Check coolant level and add if necessary. Replace Replace Clean or repair Repair Check and replace if necessary. Check and replace if necessary. Replace Adjust Adjust brake. Adjust or replace Vent air from thermostat housing bleed switch.
Water leakage of engine	• Cylinder head and cylinder block deformed or with cracks. • Cylinder head bolts loose or not tightened according to required order. • Cylinder gasket damaged • Radiator upper and lower tanks and cores damaged or welding seam crack • Drain cock not tight • Rubber hoses fractured or clamps loose • Water pump gasket damaged, screws loose or water seal invalid	Replace Tighten to required torque Replace Replace or weld again tighten Replace hose or tighten clamps Replace damaged or invalid parts. Tighten loose screws.
Engine super cool	• Auto insulation measures for winter not perfect • Lower baffles at both sides of engine missing or seriously deformed. • Thermostat not installed or damaged	Perfect insulation measures. Replace Install new thermostat.
Radiator bursting out coolant	• Cylinder head bolts loose or not tightened according to required order. • Cylinder gasket ablated or damaged • Cracks on combustion chamber wall or cylinder liner • Radiator cap faulty	Tighten to required torque Replace Replace Replace

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1.5 Ignition system

1.5.1 Ignition system

The principle of traditional ignition system of engine is shown in Fig. 1.5-1 below. The system is principally composed of a battery, an ignition switch, an ignition coil, a distributor, a high tension resistance wire and a spark plug. When the ignition switch contacts, the low voltage current from battery is developed to high tension through the ignition coil, and then is distributed to each cylinder spark plug by current distributor according to the working cycles, ignition sequence and working condition of engine. It produces a spark to ignite the compressed air-fuel mixture in cylinder and therefore make the engine operate and output power.

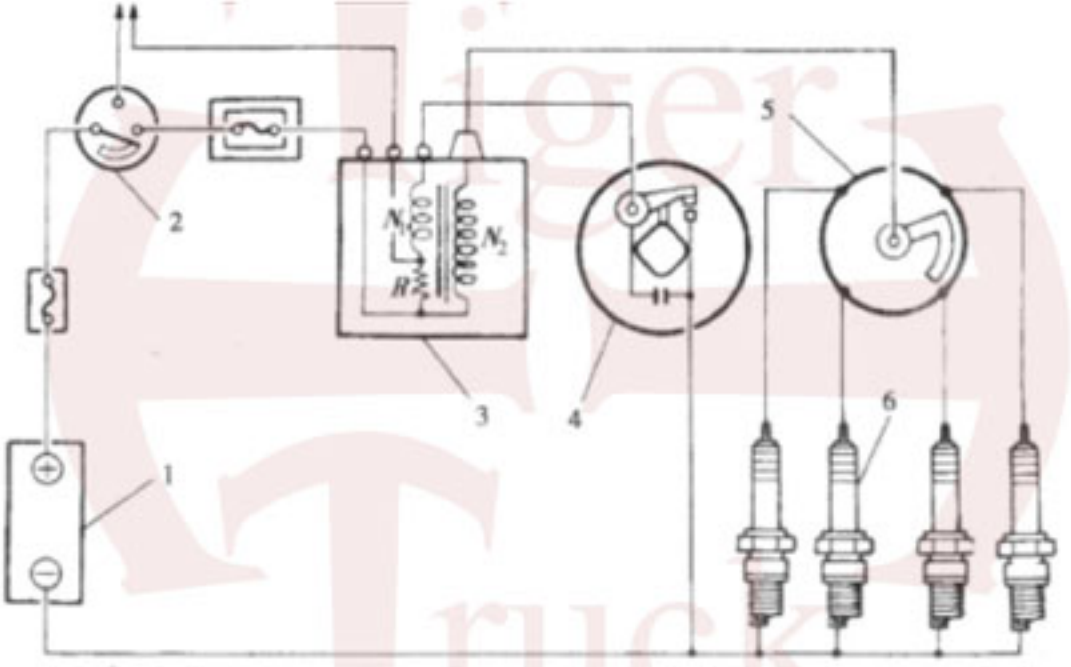


Fig. 1.5-1 Work principle of ignition system

1-battery; 2-ignition switch; 3-ignition coil; 4-current breaker; 5-current distributor; 6-spark plug

1.5.2 Ignition system maintenance

1.5.2.1 Contactless ignition system

Refer to Fig. 1.5-2 for the principle of contactless ignition system. This system does not use traditional platinum contact and has an improved ignition energy and reliable ignition. The system is mainly composed of a battery, an ignition switch, an ignition coil, a current distributor assembly, a spark plug, an ignition trigger and an ignition module.

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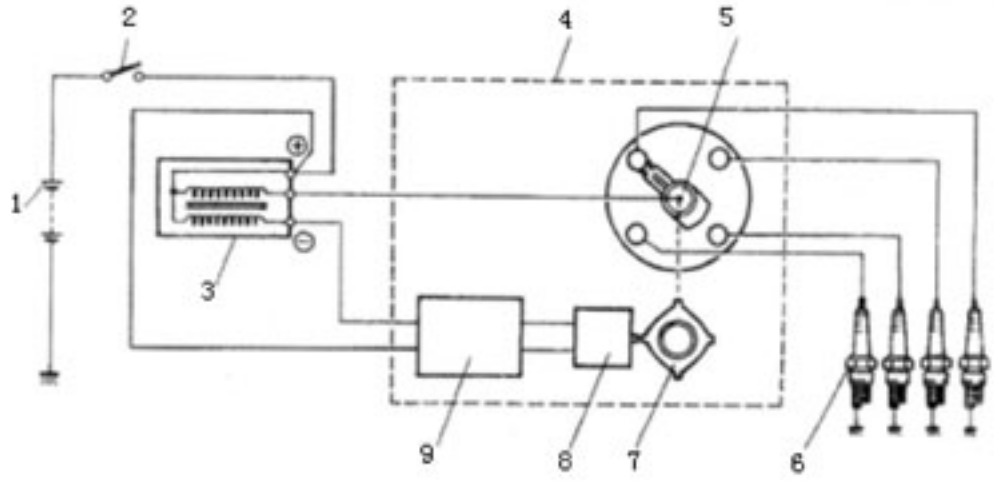


Fig. 1.5-2 Contactless ignition system

1-battery; 2-ignition switch; 3-ignition coil; 4-current distributor assembly; 5-rotating electrode; 6-spark plug; 7-timer core; 8-sensor; 10-ignition module

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1.5.2.2 Contactless current distributor

(1) Structure of Contactless current distributor (Fig. 1.5-3)

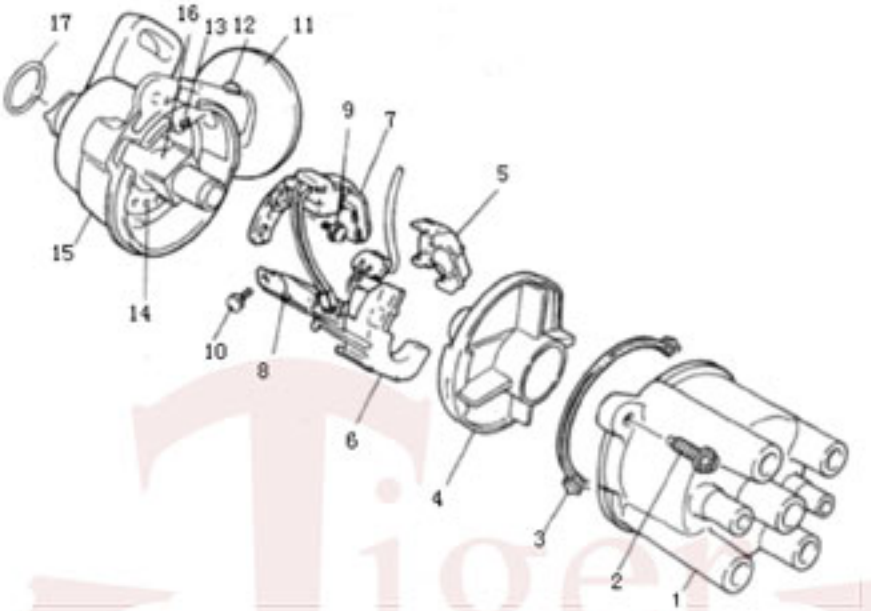
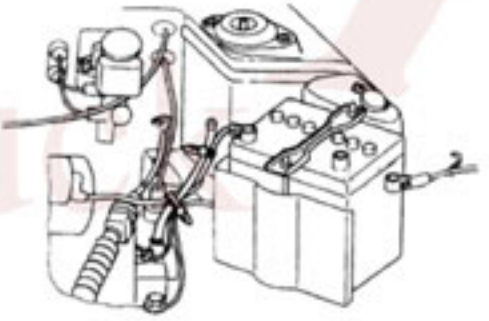


Fig. 1.5-3 Contactless current distributor

1-distributor cap; 2-distributor bolt; 3-packing ring; 4-rotating electrode; 5-sensor dust cover; 6-ignition module dust cover; 7-sensor; 8-ignition module; 9-ring of vacuum advance device; 10-mounting bolt of ignition module; 11-vacuum advance device; 12-mounting bolt of vacuum advance device; 13-ring of vacuum advance device; 14-sensor base; 15-housing of current distributor; 16-timer core; 17-packing ring

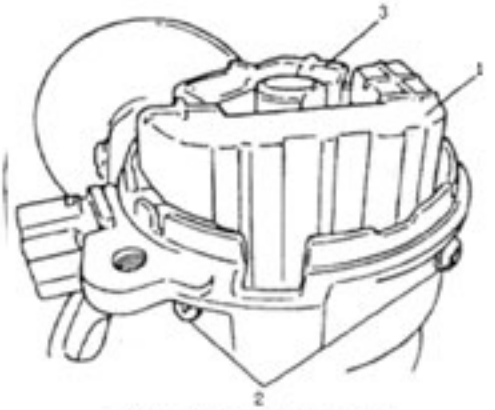
(2) Disassembly of contactless current distributor

Demount battery cathode wire and the maintenance cap of current distributor.



Demount the terminal male connector of current distributor, vacuum hose and fixing screw.

Demount current distributor cap, rotating

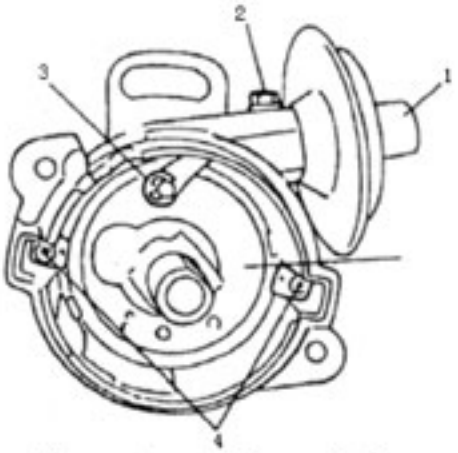


Disassemble inner connector

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electrode, ignition module and sensor.

Demount vacuum advance device locating bolt, ring, sensor base screw, and then remove vacuum advance device and sensor base.



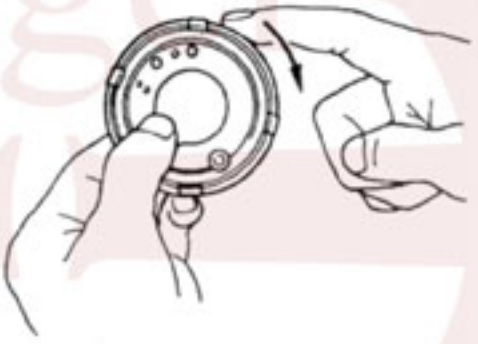
Demount vacuum advance device

1. Vacuum advance device; 2. Vacuum advance device mounting bolt; 3. Circlip; 4. Base screw; 5. Sensor base

(3)Inspection of distributor

1) Inspection of sensor base

Check sensor base for any interfered rotation, replace it if any.



2) Inspection of distributor cap

Check distributor for any cracks and defect, replace it if any.



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3) Inspection of distributor arm

Check distributor arm for any cracks and replace it if any.

4) Inspection of connectors and dust boot

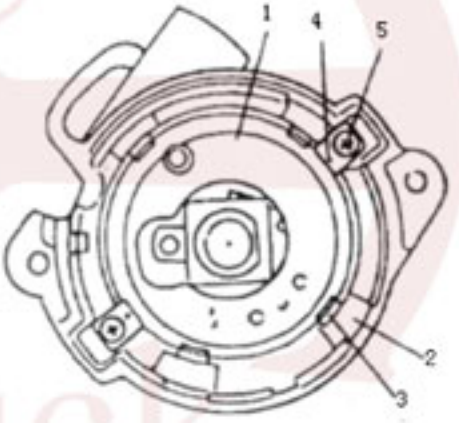
Check connectors for any corrosion or damages, and dust boot for any cracks, replace if any.



(4) Installation of distributor

1) Assembling of sensor base

Fix sensor base to distributor housing and four clips to base and align them with four slots of distributor.



Assemble sensor base plate

1. sensor base 2. slot 3. clip 4. base washer 5. base screw

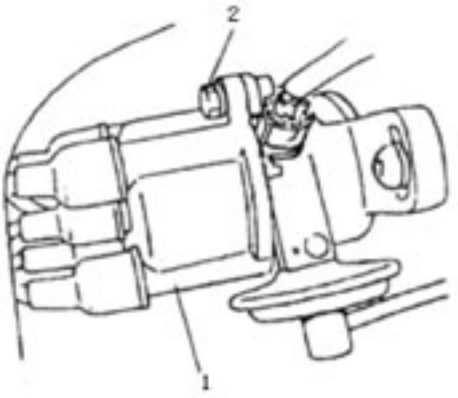
2) Assembling of sensor, ignition module

Assemble ignition module and sensor to their positions into distributor housing, replace dust boot and fix ignition module mounting bolts.



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3) Assembling of distributor cap



Assemble distributor cap

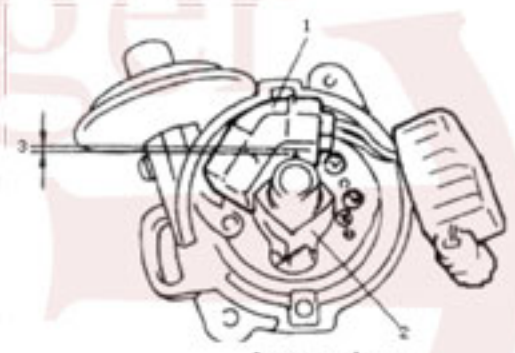
1. distributor cap 2.distributor cap mounting bolt

(5) Test of distributor assy.

1) Test of timer core air gap

Disassemble distributor cap and distributor arm to check air gap between time core ratchet and sensor with feeler gauge, and the value should conform to required standard, otherwise, adjust it.

Standard air gap: 0.2-0.4mm

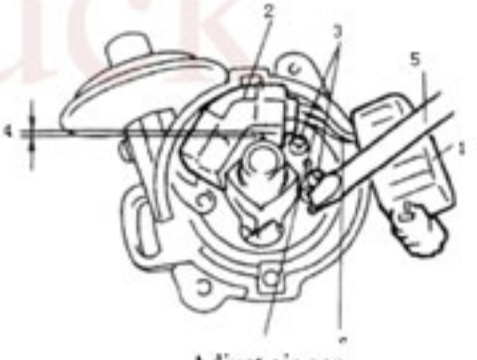


Inspect air gap

1. Sensor 2. Trigger wheel 3. Air gap

2) Adjustment of air gap

If air gap is not up to required value, disassemble distributor ignition module, loosen sensor mounting bolts, move sensor with screwdriver, adjust air gap to required value and reassemble ignition module.



Adjust air gap

1. Ignition module 2. Sensor; 3.Screw; 4.Trigger wheel air gap; 5. Flat screwdriver; 6. Hot wire; 7. White wire

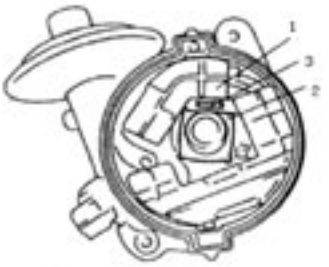
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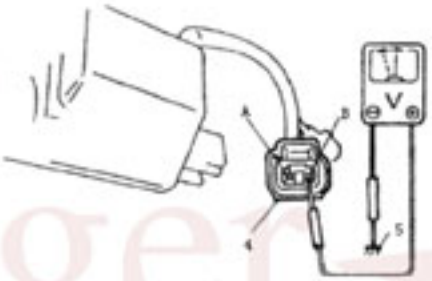
3) Test of ignition module assy.

Connect voltmeter between ignition module plug pin B and engine earth wire to assure a battery supply voltage of 12V.

Connect voltmeter between ignition module connector plug pin B and engine earth wire.

Insert screwdriver between timer core and sensor coil, quickly pull out and repeat several times. When screwdriver is puller out or inserted, voltmeter (voltage about 2.3V), and pointer will have a swing of 0.3V.



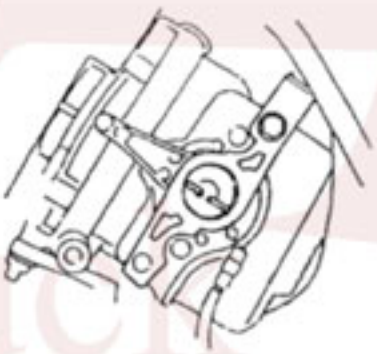


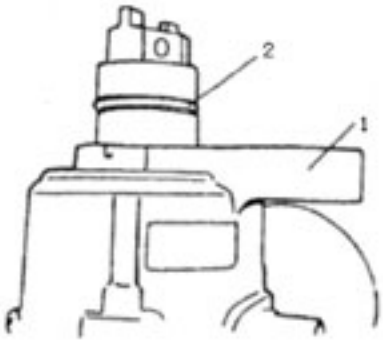
Test sensor

1. Induction coil; 2. Trigger wheel; 3. Flat screwdriver; 4. Connector; 5. Grounding wire of engine

(6) Assembling of distributor assy.

Place gasket onto distributor shaft, fix distributor into cylinder head mounting seat, insert connecting wire, connect vacuum hose and tighten mounting bolts after confirmation without any error.





Install distributor

1. distributor; 2. O-ring

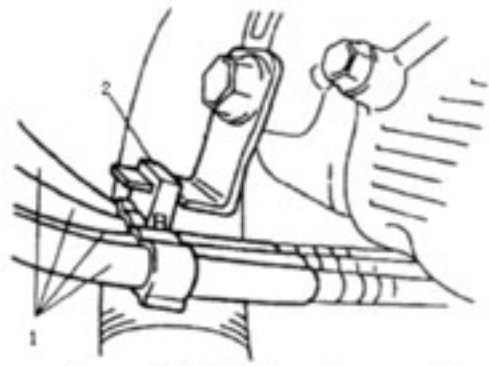
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1.5.2.3 Other ignition elements

(1) High tension damper cable

1) Disassembling of high tension damper cable.

Hold high tension damper rubber bushing, pull out high tension damper cable from ignition coil and spark plug, loosen cable clip to remove high tension damper cable.

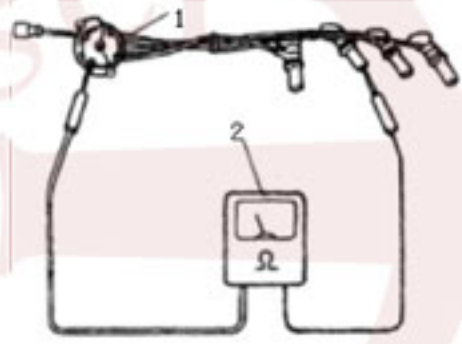


Remove high tension damper cable
1. high tension damper cable; 2. cable clip

2) Test of high tension damper cable

Test high tension damper cable with ohmmeter and the value should conform to requirement; otherwise replace it.

Standard resistance of high tension damper cable: 10-22kΩ/m

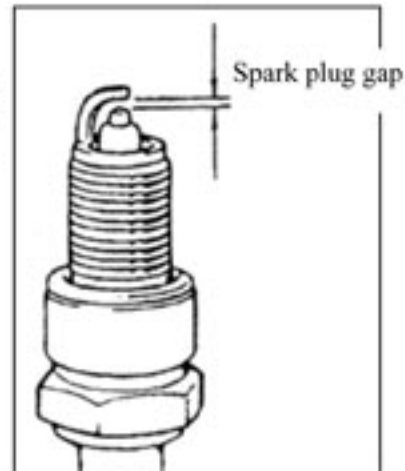


Test high tension damper cable
1. high tension damper cable; 2. ohmmeter

(2) Spark plug

Spark plug surface should be clean and free of carbon; insulator should have no damage; electrode gap of spark plug should conform to requirement; otherwise, adjust or replace spark plug.

Standard gap: 0.7-0.8mm



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(3) Ignition coil

At ambient temperature (about 20□), test primary coil resistance, which should conform to requirement; otherwise, replace ignition coil.

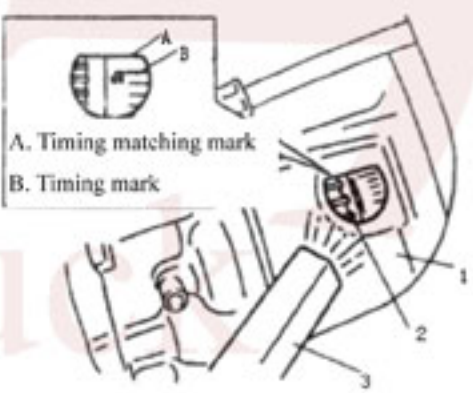
Standard resistance of primary coil: 1.08-1.32Ω



1.5.4.2 Ignition timing

(1) Inspection of ignition timing

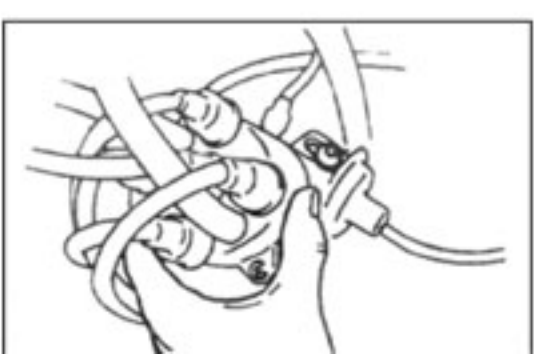
Connect timing light to first cylinder high tension damper cable to start idle revolution of engine; at the same time, make timing light facing timing sight glass and align timing scale line A with timing matching mark. Otherwise, adjust it.



Inspect ignition timing
1. Clutch housing 2. Flywheel 3. Timing light

(2) Adjustment of ignition timing

If ignition timing is not up to requirement, loosen distributor mounting bolts to make adjustment by turning distributor assy.



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during engine running.

1.5.3 Trouble Shooting

Common trouble	Trouble analysis			Method
	Trouble location		Cause	
Engine cannot be started.	Primary side circuit trouble	Circuit between ignition switch and distributor	Brakeage, short circuit or poor contact	Check and tighten connectors and replace leads if necessary.
		Voltmeter, ignition switch or fuse	Voltmeter, ignition switch or fuse are damaged to cause damage to primary side circuit.	Replace voltmeter or ignition switch
		Ignition coil	Primary side circuit breakage or additional resistance damaged	Replace ignition coil or additional resistance.
		Traditional ignition system: Breaker	Contact oxidized, ablated.	Clean or replace contact
			Fixing contact earth improper	Repair connector
			Terminal or moving contact earth	
		Traditional ignition system: Capacitor	damaged	Replace
		Semi-conductor ignition system: sensor	Sensor coil short circuit, breakage, or earth	Repair or replace
			Improper clearance between rotor tooth and core	Adjust
			Hall element damaged.	Replace
		Semi-conductor ignition system: Ignition controller	damaged	Replace
	secondary side circuit trouble	Distributor cap or distributor arm	leakage	Replace
		High tension lead	Leakage or resistance too big	Replace
		Spark plug	Carbon fouling serious	Remove carbon or replace
			leakage	Replace
	o n	distributor	Distribution installation	Readjust ignition

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			error	timing
		harness	Spark plug high tension harness error	Adjust harness
Engine running not stable	Ignition timing		Improper adjustment of ignition timing	readjust
			Ignition advance regulator faulty	Repair or replace
			Distributor shaft loose, breaker cam wear uneven	Replace distributor
	Spark plug		Some spark plug insulation damaged or spark plug carbon too much	Replace spark plug
	High tension lead		Some cylinder high tension leads damaged or pulled out.	Check and replace if necessary.
Engine power decreased, fuel consumption increased, acceleration performance poor.	Ignition timing		Improper adjustment of ignition timing, ignition advance angle too big or too small	Adjust ignition timing
			Ignition advance regulator faulty	Repair or replace distributor
	breaker		point gap too big	Adjust
Engine can be started by connecting ignition switch, and stopped by disconnectin g ignition switch.	Additional resistance		Ignition coil additional resistance or addition al resistance wire damaged.	Replace

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1.6 Starting System

Starting System

1.6.1.1 Schematic Circuit Diagram of Starting System

The starting system consists of storage battery, starting motor, ignition switch, solenoid valve and leads for relevant electrical appliances, and so on. The schematic circuit diagram is shown in Figure 1.6- 1.

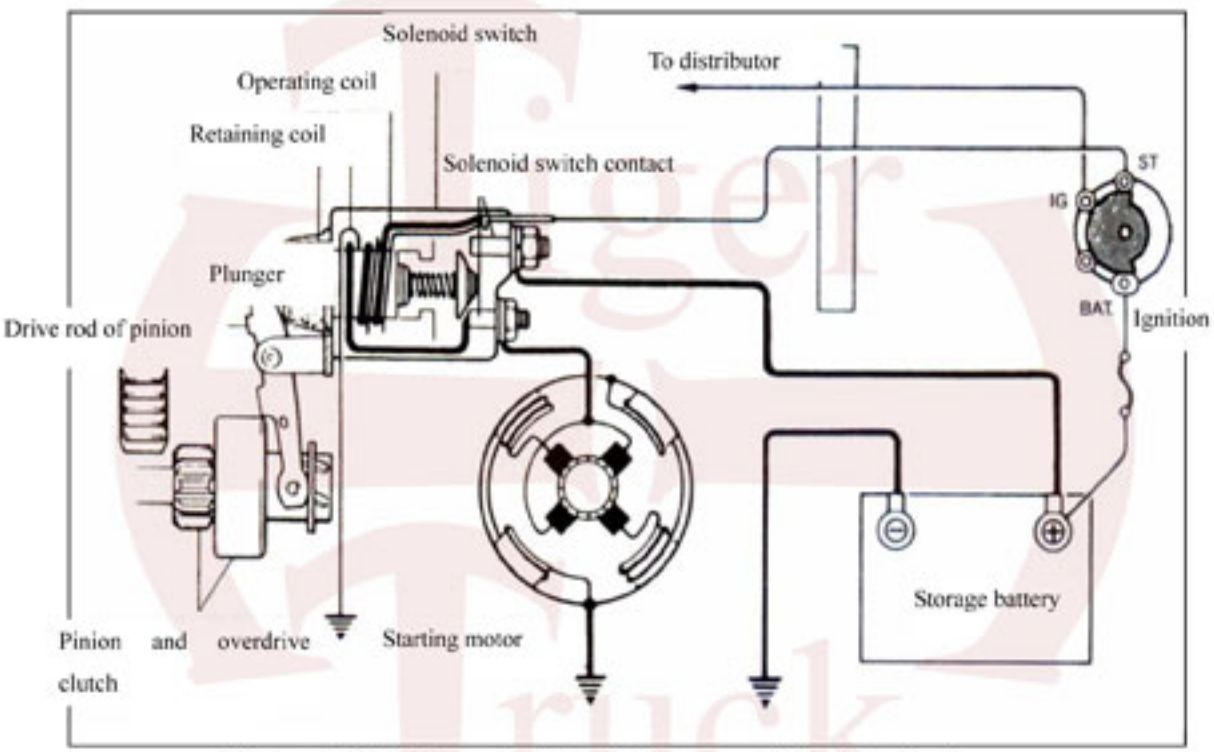


Figure 1.6-1 Schematic Circuit Diagram of Starting System

When the ignition switch is powered on, the solenoid valve coil switches on and produces magnetic field; the piston moves to pull the drive gear lever, and impel the unidirectional clutch moving. It causes the drive gear and the flywheel ring gear engaged, and actuates the flywheel revolved, so as to start the engine.

After the engine started, the unidirectional clutch interrupts the flywheel power and turns reversely; the starting motor should be protected. When the ignition switch returned to the normal work position of the engine, the solenoid valve switches off; return spring makes the piston returned to the position; the drive gear separates from the flywheel ring gear.

1.6.1.2 The structure and parts of the starter are shown in Figure 1.6- 2.

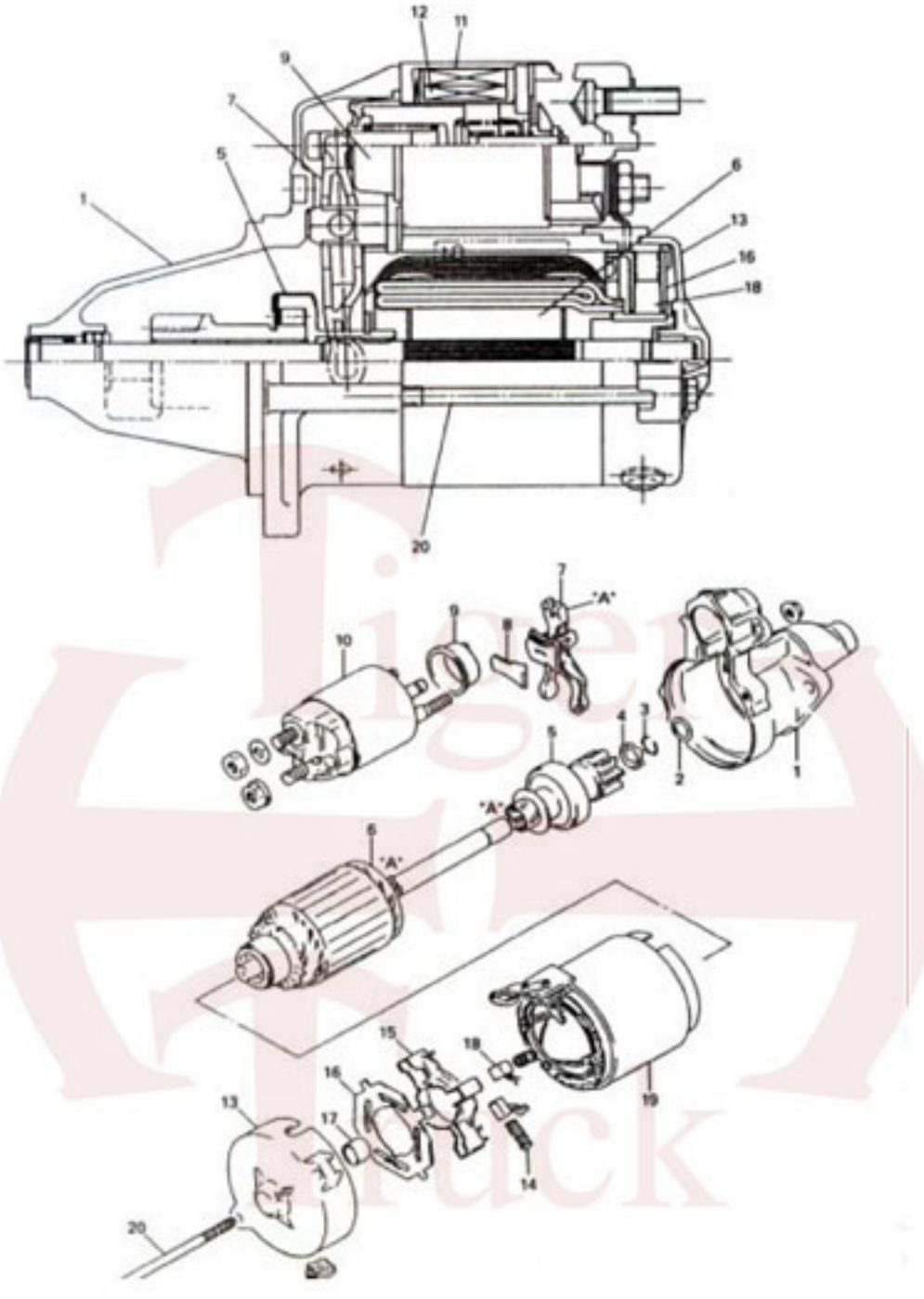


Figure 1.6- 2 Structure and parts of starting motor

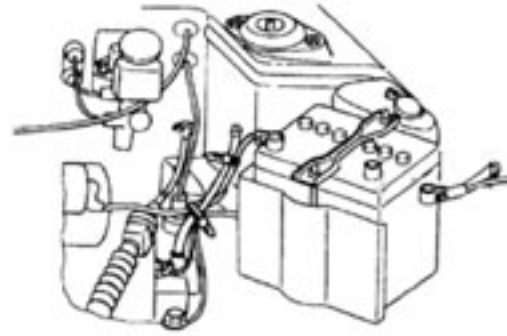
1-Drive end cover assembly; 2-Washer; 3-Hold-down ring; 4-Stop ring for drive gear; 5-Unidirectional clutch;6-Armature;7-Drive gear level; 8-Sealing element; 9-Envelope of hood; 10-Solenoid valve; 11-Retaining coil; 12-Operating coil; 13-Back cover; 14-Brush spring; 15-Brush rocker; 16-Insulator;17, 18-Bushing; 19-Stator assembly; 20-Outer shell bolt

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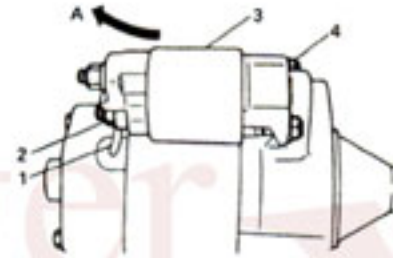
1.6.2 Maintenance of Starter

1.6.2.1 Disassembly of Starter

(1) Remove the negative lead of the storage battery



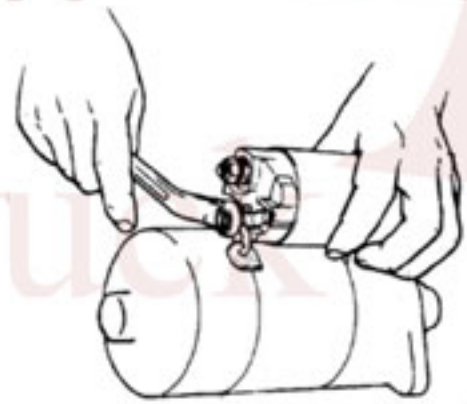
(2) Disconnect the cable for solenoid valve of the starter



1. Lead
2. Nut
3. Solenoid switch
4. Nut
A. Pull to disengage the internal hook

(3) Remove the two mounting screws for engine and flywheel casing.

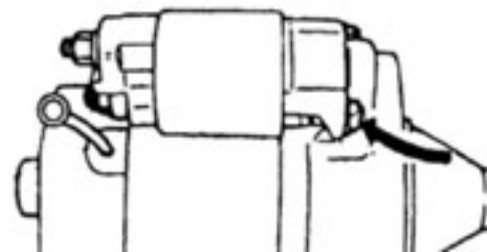
(4) Take off the starter assembly.



1.6.2.2 Dismantling of Starter

(1) Disconnect the connecting lead for solenoid valve and the starter.

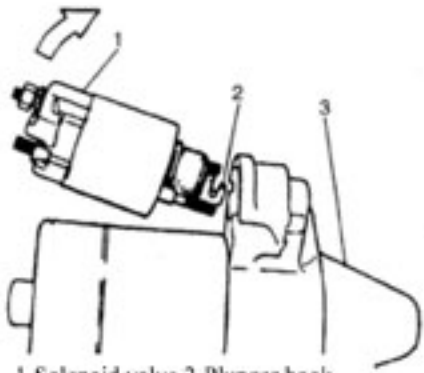
(2) Loosen the tightening nut of the connecting bolt for the solenoid valve and



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the starter.

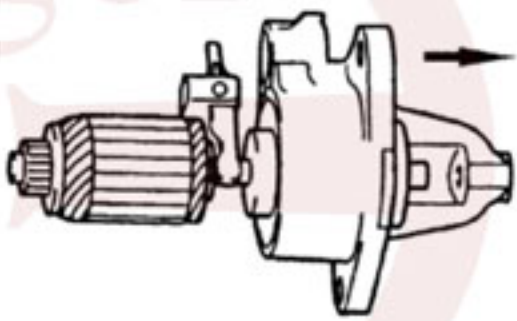
(3) Remove the solenoid valve.



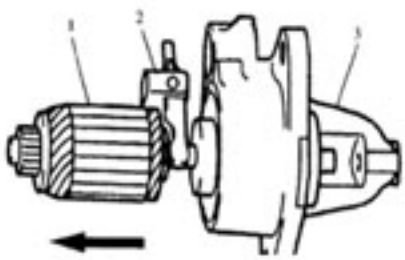
1-Solenoid valve 2-Plunger hook 3-Starter casing

(4) Remove the tightening bolt in the middle of the starter cover, and then pull out the commutator end head.

Note: when disassembling, protect the easily damaged parts such as brush, brush spring, and brush retainer carefully to prevent damages.



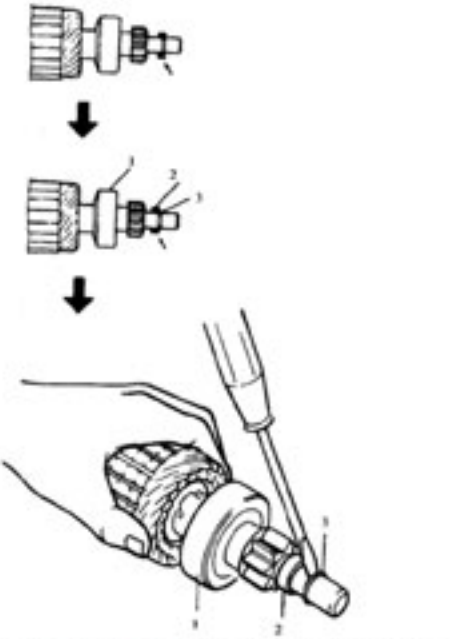
(5) Disassemble the stator and armature assembly.



1- Armature assembly 2-Drive rod of pinion

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(6) Disassemble the unidirectional clutch.



1- Unidirectional clutch 2- Stop ring 3- Clamping spring

(7) Disassemble the brush rocket.



1.6.2.3 Overhaul for Starter

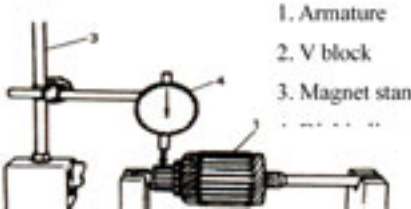
(1) Overhaul for commutator working surface

If the commutator surface is dirty, it can be cleaned with clean gasoline; if slight ablation occurs on the commutator surface, it can be polished with No. 300 - 400 gauzes; and the lathe can be used for turning if the ablation is serious.



(2) Out of Circularity Inspection for Commutator

Measure the cylindricity of the commutator with dial indicator, and then read the number on the dial indicator. Repair or replace the rotor



1. Armature
2. V block
3. Magnet stand

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assembly if the non-circularity of the commutator surpasses the limit value.

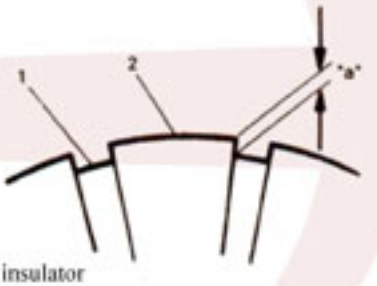
(3) Diameter Inspection for Commutator

Measure the diameter of the commutator with vernier caliper. Replace the rotor assembly if the outer diameter is less than the operating limit.



(4) Depth Inspection for Mica Lamination

Check the depth for mica lamination of con its depth is less than specified operating limit; re

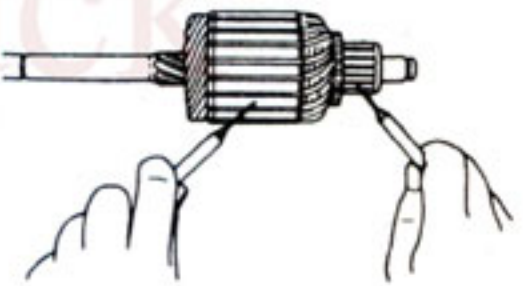


1- Mica insulator

2- Commutator

(5) Earth Inspection for Rotor

Check that if it is insulated between the rectiblock of the commutator and the cored winding of rotor with multimeter resistance. If it is conducted, it indicates that the earth occurred in the rotor winding, the rotor assembly should be repaired or replaced.



(6) Open Circuit Inspection for Rotor

Check that if it is conducted between the



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rectiblocks of the commutator with multimeter resistance. If it is not conducted, it indicates that the open circuit occurred; the rotor assembly should be replaced.

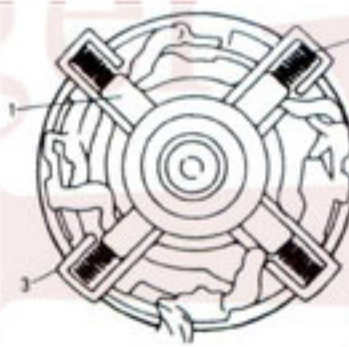
7) Inspection of the Brush Length

Measure the length of the brush. If the wear of brush is beyond the operating limit, the brush should be replaced.



8) Inspection of the Brush Rocket

Check the brush seat plate and the brush rocket. If the brush seat plate and the brush rocket damaged or low insulation occurred, the retaining plate should be repaired and replaced.



1- Brush
2-Brush spring
3-Brush rocket

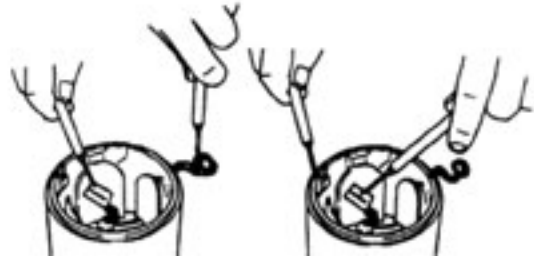
(9) Inspection of the Brush Spring

Check that if the spring force is lower than operating limit or the spring has any other abnormal conditions. Replace it if it is defective.



(10) Inspection of field coil

Check the conduction situation of field coil with multimeter. Replace the coil if open circuit or



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short circuit occurs.

(11) Inspection for drive rocker of pinion

Check that if the drive lever, rod end yoke, spring of the starting pinion of generator is being worn or distorted, and interfered; lubricate, adjust or replace them depended on the need.



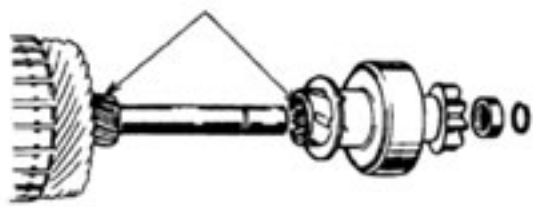
(12) Inspection of Unidirectional Clutch

Rotate the pinion; inspect the attrition situation of the gear and working condition of the unidirectional clutch. If the pinion got heavy wear; the wheel teeth damaged or any other abnormal conditions occurred, and the unidirectional clutch failed, the unidirectional clutch should be replaced.



(13) Inspection of the Spline on Rotor Shaft

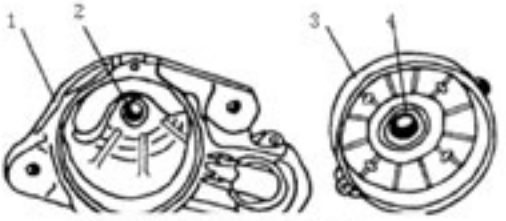
Pull the unidirectional clutch outward from the rotor shaft; check that if the spline on rotor shaft and the splined hub of clutch is worn or damaged. If the spline tooth is damaged, the unidirectional clutch or the rotor shaft should be replaced; when the spline is lubricated insufficiently, the spline tooth should be cleaned and re-lubricated.



(14) Inspection of End Cover Bearing and Bushing

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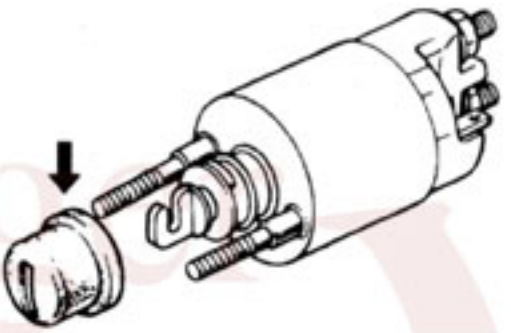
Check the front and back end covers and bushings. If any crack, damage, and distortion occurred in the end cover, it should be replaced; if the bushing or the bearing got heavy wear, they should be replaced and be lubricated.



1- Front end cover 2- Bushing
3- Back end cover 4-Bushing

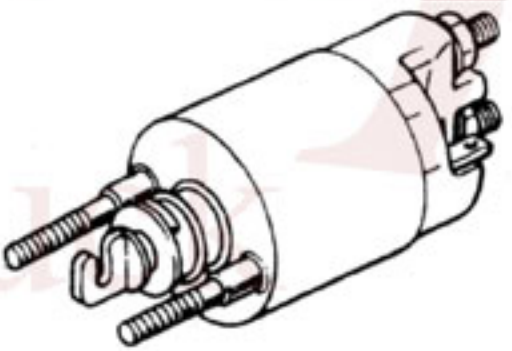
(15) Inspection for Dust Cover of Solenoid Valve

Check that if the dust cover of the solenoid valve is being aged or broken. If it is defective, it should be replaced.



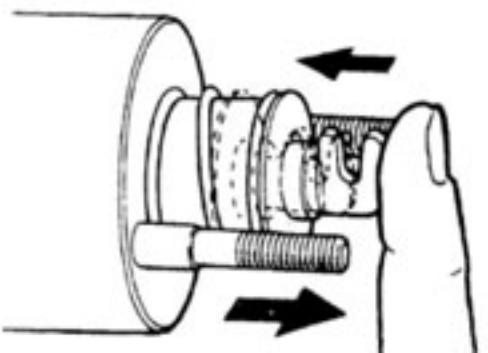
(16) Wear Condition Inspection of Magnet Plunger

Check the wear condition of the magnet plunger; replace it if necessary.



(17) Restoration Condition Inspection of Magnet Plunger

Press in the magnet plunger with hand, and release it quickly; observe the movement status of the plunger. If any jamming during pressing in and it can not restore quickly during releasing, the

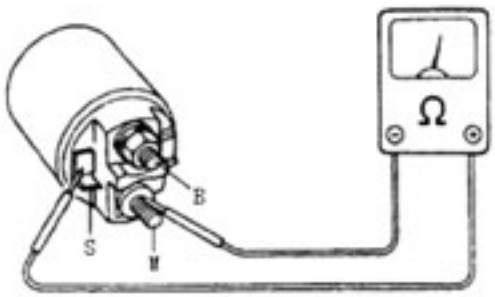


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solenoid valve should be replaced.

(18) Inspection for Sucking Coil of Solenoid Valve

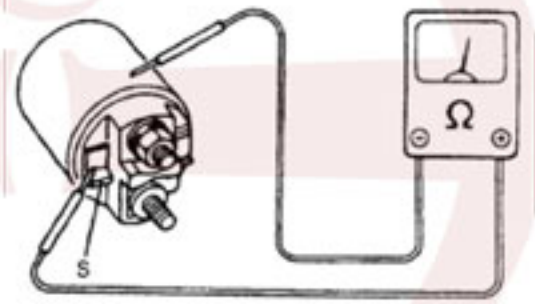
Check the conduction conditions between the S and M wiring terminal of the solenoid valve with multimeter. If there is non-conduction between the S-terminal and M-terminal, which indicates that the sucking coil is broken, the solenoid valve assembly should be replaced.



jB-Wiring terminal for storage battery
M-Wiring terminal for exciter winding
S-Wiring terminal for magnetic coil

(19) Inspection for Retaining Coil of Solenoid Valve

Check the conduction conditions between the S wiring terminal of the solenoid valve and the casing with multimeter. If there is non-conduction between the S-terminal and the casing, which indicates that the retaining coil is broken; the solenoid valve assembly should be replaced.



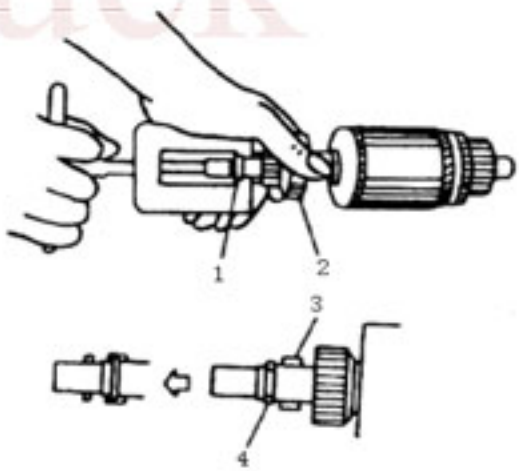
1.6.2.4 Assembly of Starter

Assembly of Starter

The assembly order for starter is contrary to the disassembly process, but the following matters must be paid attention to during assembling:

(1) Installation of Stop Ring and Snap Ring of Unidirectional Clutch

Mount the unidirectional clutch and drive pinion onto the rotor shaft, and then mount the stop ring and snap ring



1- Stop ring 2- Unidirectional clutch
3- Snap ring 4- Drag hook

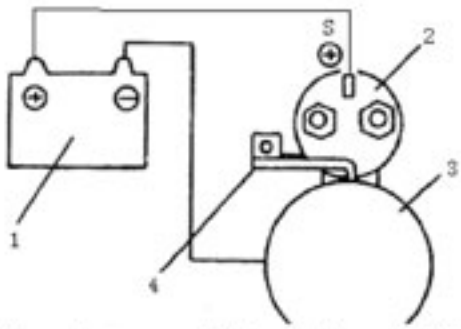
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on the shaft end.

(2) Adjustment of the space between drive pinions

1) Outward movement testing for drive pinions

Disassemble the M-terminal field winding wiring of the solenoid valve; connect the battery terminal positive to S-terminal, and the negative to the starter casing, and then switch the current on; this moment, the gear should move outward.



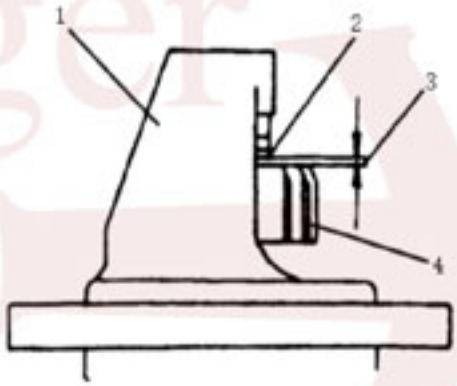
1- Storage battery 2- Solenoid valve 3- Starter
4- M-terminal

Note: When taking this test, in order to avoid burning down the solenoid valve, the test time should not surpass 10s.

2) Measurement for tooth space of the drive pinion

Measure the space between the drive pinion and stop ring with step filler gauge or caliper when the drive pinion moves outward to the position of maximum displacement. The space value should within the specified scope, otherwise it should be adjusted.

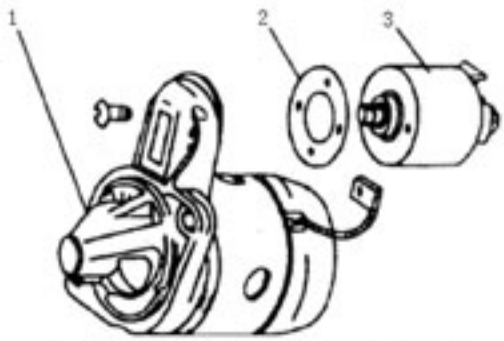
The space value: 1- 4mm



1-Drive end cover of starter; 2-Stop ring; 3-Space; 4-Drive pinion

(3) Adjustment for the tooth space of drive pinions

If the tooth space of the drive pinion does not conform to the specified standard value, it can be adjusted by increasing and reducing the washer between the solenoid valve and the starter casing. At the same time, the tooth space of the drive gear can be adjusted by adjusting the length of double end stud.

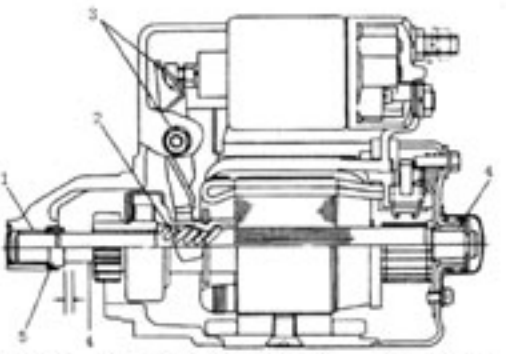


1-Starter; 2-Adjusting washer; 3-Solenoid valve

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1.6.2.5 Main Lubricant Site in Starter Assembling Process

During assembling starter, the main moving part should be lubricated so as to guarantee the movement parts had good lubrication condition, and make the starter worked reliability. The lubricant sites of starter are shown in the Figure



1- Busing 2- Spline on rotor shaft 3- Drive rod
4- Busing 5- Stop ring

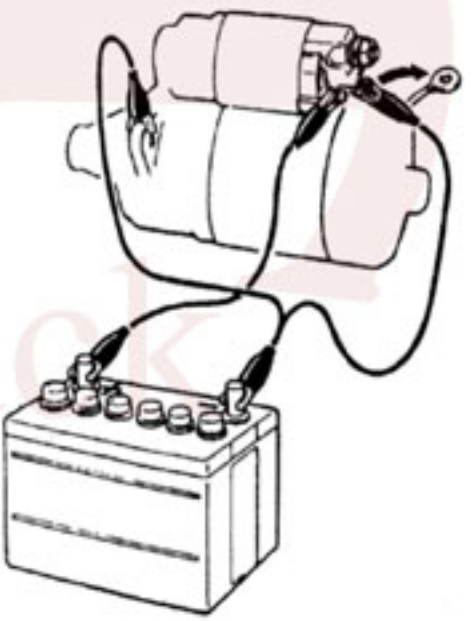
1.6.2.6 Testing of Starter

After the overhaul for starter, the necessary performance testing should be taken to inspect the assembly quality and the working condition after assembling, and ensure it worked normally. After the starter is assembled, the traction test, the maintenance test, the restoration test and the performance test should be taken.

Note: the testing time should be controlled within 3 - 5s to avoid burning out the coil.

(1) Traction Test

Disconnect the field winding wiring from the wiring terminal of the solenoid valve, then connect the lead following the Figure, and then check the working conditions of the solenoid valve. If the solenoid valve is engaged; and the moving distance of the drive pinion conforms to the specified scope; it indicates that the solenoid valve is normal; Otherwise the solenoid valve should be replaced.

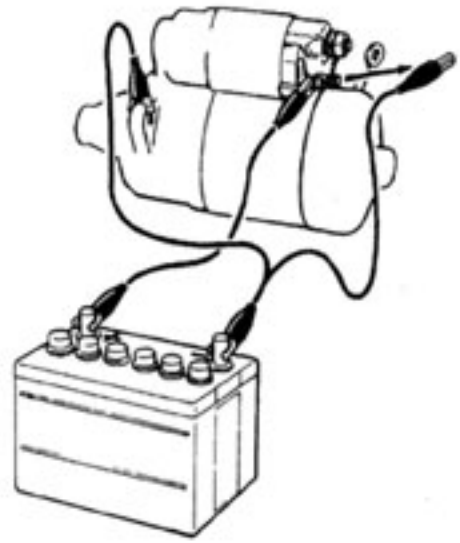


Tooth space: 1- 4mm

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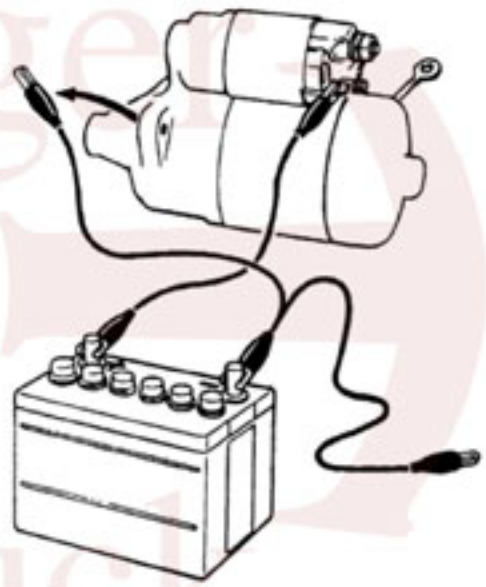
(2) Maintenance Test

Connect the line; disconnect the negative wire from M-terminal of the solenoid valve if the magnet plunger stretches out, as shown in right Figure. Then observe that if the magnet plunger is kept stretching out. If the magnet plunger retracted inward, it indicates that the performance of solenoid valve is not good, it should be replaced.



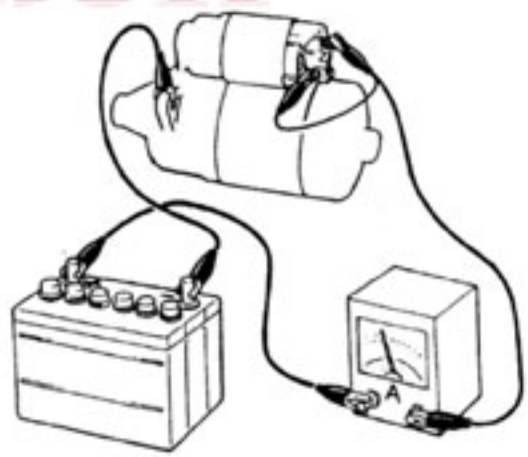
(3) Restoration Test

Disconnect the negative wire from the starter casing, and then check that if the magnet plunger and the drive pinion is restored. If the magnet plunger and the drive pinion can not restore, it indicates that the solenoid valve had some failures, the solenoid valve should be replaced.



(4) Performance Test

Connect the field winding wiring to the wiring terminal of the solenoid valve again, connect an ammeter in series between the storage battery and the starter (measuring range 100A), then switch the circuit on. At this time, if the starter revolves smoothly and the drive pinion moves out steadily, and the ammeter reading is smaller than 50A (storage battery voltage is 11V); the above indicates that the performance of the starter is good. Otherwise check it again.



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1.7 Charging System

1.7.1 Charging System

1.7.1.1 Schematic Circuit Diagram of Charging System

The charging system consists of alternator, voltage regulator, rectifier, ignition switch, storage battery, indicator light and lead. The integrated circuit charging system is used for SC1021 series truck.

Schematic circuit diagram of integrated circuit charging system is shown in Figure 1.7-1.

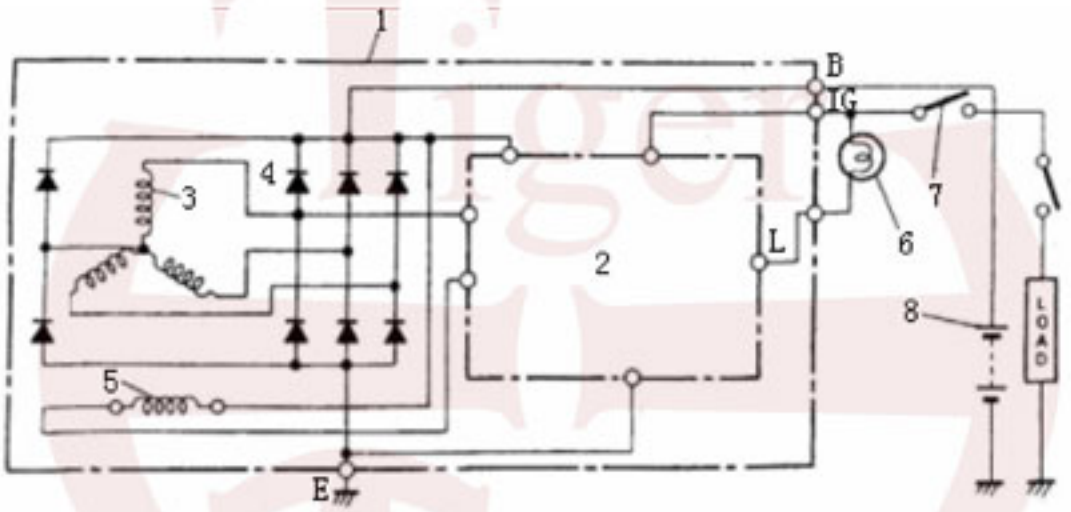


Figure 1.7-1 Schematic Circuit Diagram of Integrated Circuit Charging System

1-Built-in regulator generator; 2-Integrated circuit regulator; 3-Stator coil; 4-Diode; 5-exciter winding; 6-Charge indicator light; 7-Ignition switch; 8-Storage battery

The regulator of generator is the hybrid integrated circuit regulator which consists of a monolithic integrated circuit and dynatron and so on, thus it makes the alternator worked reliability; at the same time, the integrated circuit regulator has excellences such as small volume, and maintenance free and so on.

When the ignition switch is in the "ON" position and the engine is not run, the voltage of storage battery inputs into the integrated circuit regulator through the terminal "IG" to break over the dynatron V1 and V2 simultaneously, and make separate excitation as the current flows across the generator field winding; the charge indicator light lightens to instruct the generator not to work. After the generator runs, its output voltage is higher than the voltage of storage battery; the dynatron V2 stops; the charge indicator light extinguishes automatically to indicate that the generator works normally. When

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the voltage of generator increases to 13.9 - 15.1V with the risen in speed of engine, the integrated circuit regulator can interrupt the current in the generator field winding to reduce the voltage of generator, thus it can adjust the output voltage of the generator and keep it at 14.4 - 15.0V.

1.7.1.2 Main Technical Parameter for Charging System

Vehicle model	JL465Q5	JL474Q	YD480
Generator model	JFZ176E	JFZ171	JFWZB19
Rated voltage	14V		
Standard output current	70A		65A
Earth polarity	Negative earth		

1.7.2 Storage Battery

1.7.2.1 Model and Specification of Storage Battery

The model and specification of storage battery is as below.

Vehicle model	Diesel-engined vehicle	Gasoline-engined vehicle
Storage battery model	6-QA-120Ah	6-QW-45Ah
Voltage	12	12
Electric capacity(Ah)	120	45

1.7.2.2 Disassembly of Storage Battery

(1) Open the engine maintenance lid and engine chamber cover.

(2) Disconnect the negative lead of the storage battery.

(3) Disconnect the positive lead of the storage battery.

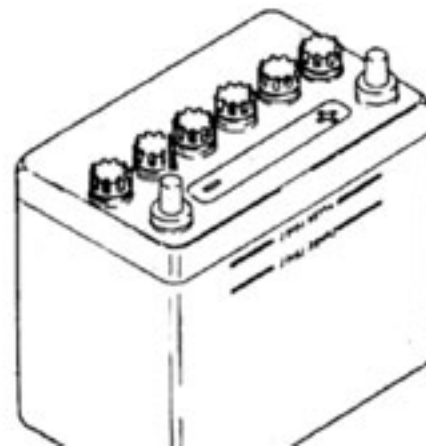
(4) Remove the fixing strap of the storage battery.

(5) Take out the storage battery from the battery box.

1.7.2.3 Inspection of Storage Battery

(1) Check that if the battery housing is damaged and broken. Replace the storage battery if the electrolyte leaks or the storage battery breaks.

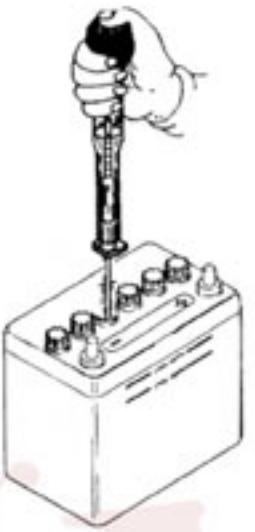
(2) Check that if the electrolyte level is between the "UPPER LEVEL" scale and the "LOWER LEVEL" scale, if it is lower



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than the "LOWER LEVEL" scale, the distilled water should be added in time.

(3) Check the electrolyte density so as to estimate the discharge degree of storage battery approximately.



The temparature of battery electrolyte is 20□.

If the electrolyte density is 1.280g/cm^3, the storage battery is on fully charged state.

If the electrolyte density is 1.220g/cm^3, the storage battery is on semi charged state.

If the electrolyte density is 1.150g/cm^3, the storage battery is close to fully discharged state; and the electrolyte freezes.

The measured electrolyte density and standard electrolyte density (20□) can be converted as follows:

$$\gamma_{20} = \gamma_t + 0.0007(t - 20)$$

In the above formula, γ_{20}--value of standard electrolyte density at 20□;

γ_t--the measured density value at t□;

t--the temperature of electrolyte;

0.0007--temperature coefficient.

1.7.2.4 Maintenance of Storage Battery

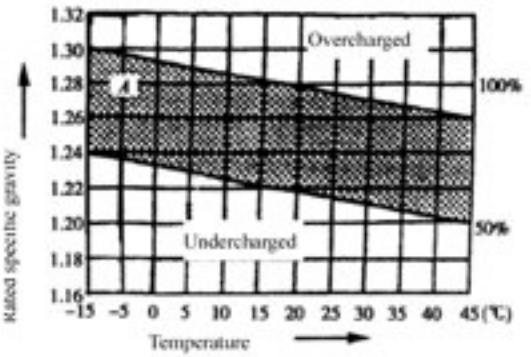
(1) Often check that if the storage battery is fixed firmly with the clamp plate of fixing strap and if the pressing force is suitable.

(2) Keep the storage battery surface clean; remove the superficial filth to keep the vent hole of charging cover flowing.

(3) Clear the oxide on the terminal; tighten the wiring clips for positive lead and negative lead to keep the wiring clips and the terminal connected stability.

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(4) Pay attention to the charge and discharge condition of the storage battery at any time so as to prevent the storage battery over discharging.



(5) Charge and discharge for the storage battery at certain times. Don't leave the storage battery under discharging condition for a long time so as to prevent the storage battery plates vulcanizing.

1.7.2.5 Installation of Storage Battery

(1) Install the storage battery based on the reverse procedure to the disassembly.

(2) Screw the wiring clips for positive lead and negative lead of the storage battery, and then cover the insulating sheath inside of the terrine.

1.7.2.6 Matters need attention during usage for storage battery

(1) The storage battery is not allowed to charge and discharge for a long time with heavy current.

(2) The discharge degree of the storage battery should not surpass 50% so as to avoid reducing the service life.

(3) When starting the engine, the time to switch the starting motor should not more than 5s; the reigniting time interval should not smaller than 15s; if the starting fails three times continuously, please search the reason.

(4) The gas caused by charging and discharging of the storage battery is flammable and explosive, therefore the open fire or the electric spark is not allowed to approach.

(5) The electrolyte is a kind of corrosive acid liquor, it cannot contact eyes, skin, fiber and surface of paint; If contact it carelessly, rinse out thoroughly with clean water immediately.

1.7.3 Alternator

1.7.3.1 AC Generating Set

(1) Alternator for JL465Q engine (Figure 1.7-2)

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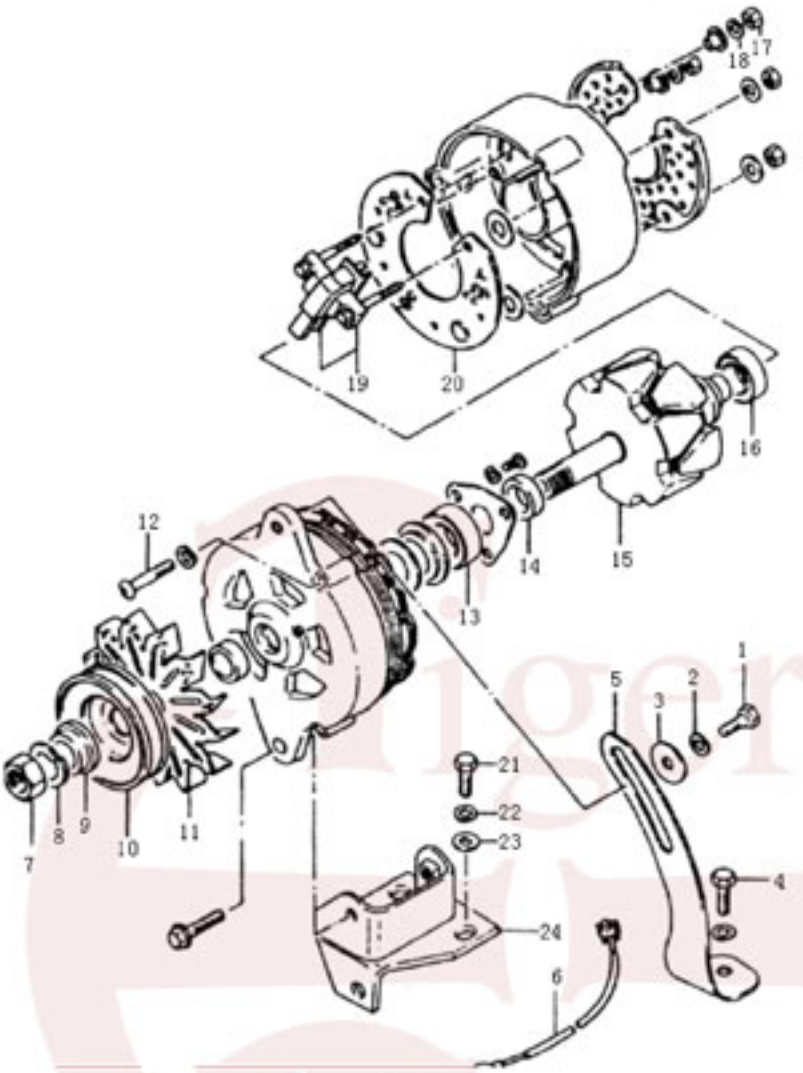


Figure 1.7-2 Alternator for JL465Q Engine

1, 4, 12, 21-Bolt; 2, 8, 18, 22-Spring washer; 3, 23-washer; 45-Generator support; 6-Lead; 7, 17-Nut; 9-Shaft housing; 10-Belt pulley; 11-Fan; 13-Bearing; 14-Spacer sleeve; 15-Rotor; 16-Bearing; 19-Brush module; 20-Rectifier assembly; 24-Generator bracket

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1.7.3.2 Alternator for JL474Q engine (Figure 1.7-3)

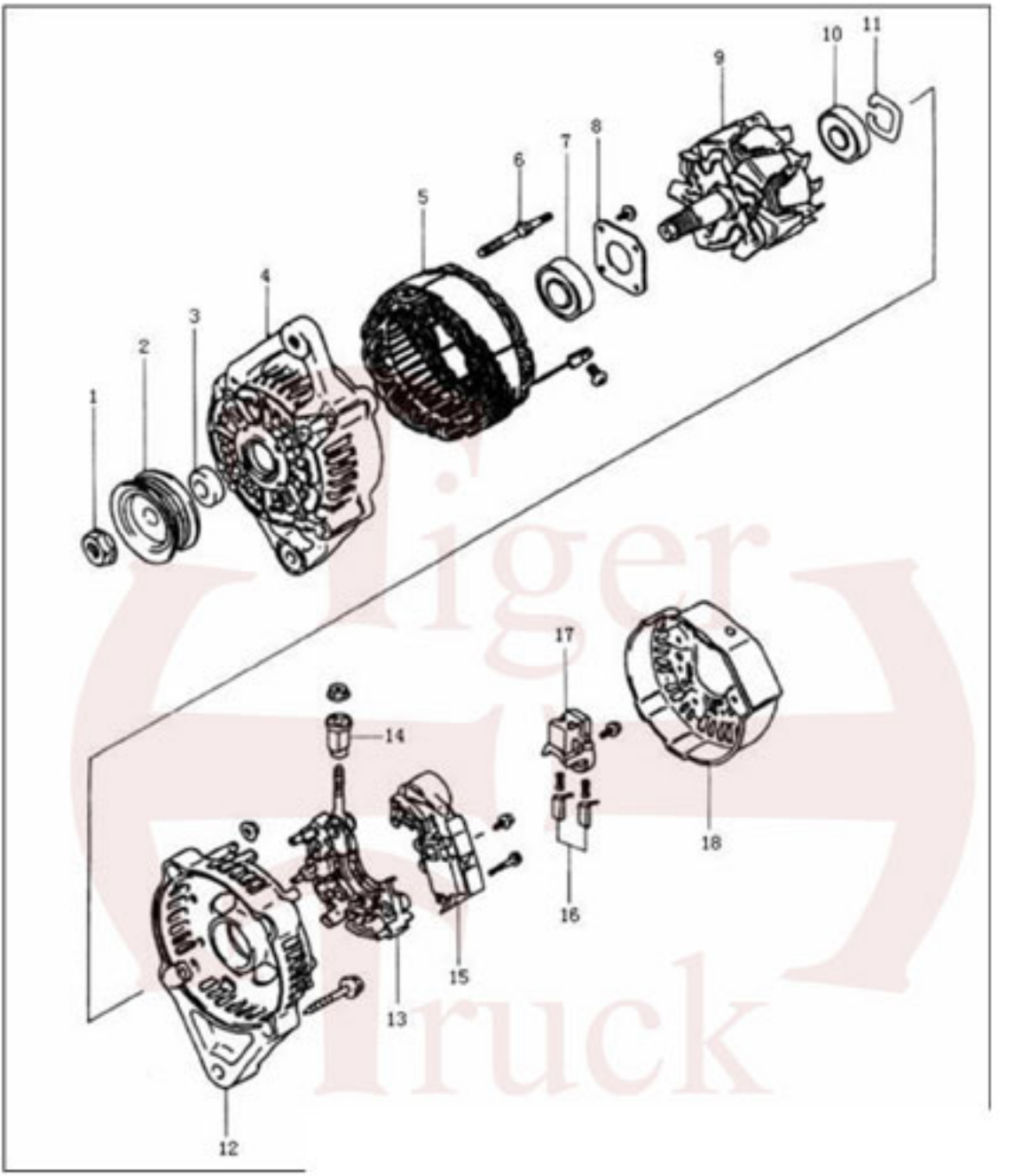


Figure 1.7-3 Alternator for JL474Q Engine

1-Pulley nut; 2-Belt pulley; 3-Spacer sleeve; 4-Drive cover; 5-Stator; 6-double end stud; 7-Drive end bearing; 8-Bearing retaining ring; 9-Rotor; 10-Back bearing; 11-Bearing cap; 12-Back-end cover; 13-Rectifier; 14-Insulating part; 15-Regulator; 16-Brush; 17-Brush rocker; 18-Back-end shield

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1.7.3.2 Structure of Alternator (Figure 1.7-4)

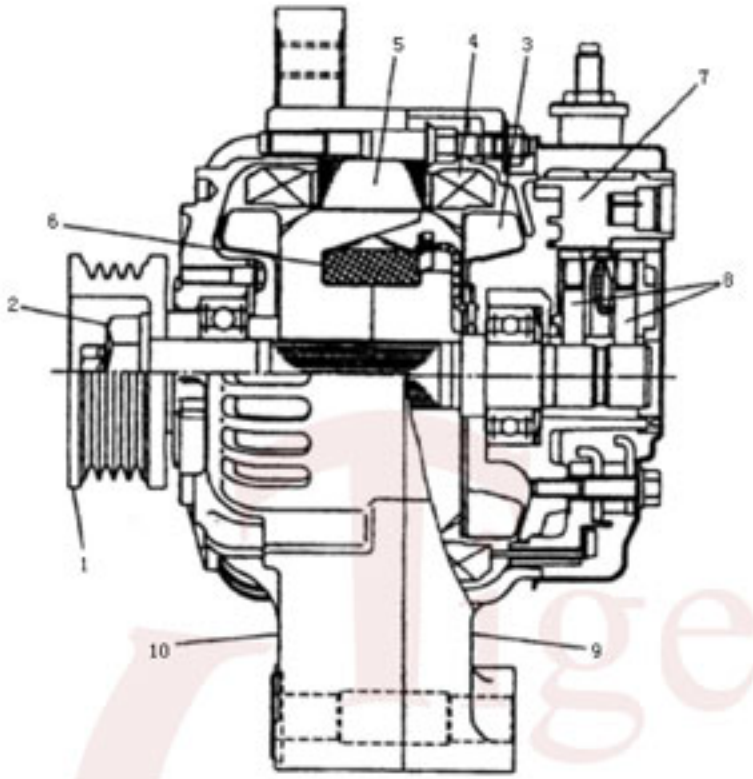


Figure 1.7-4 Structure of Alternator

1-Belt pulley; 2-Pulley nut; 3-Fan; 4-Stator coil; 5-Stator core; 6-Rotor coil; 7-Regulator; 8-Brush; 9-Back-end cover; 10-Drive end cover

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3.3 Wire Connecting Terminal of Alternator (Figure 1.7-5)

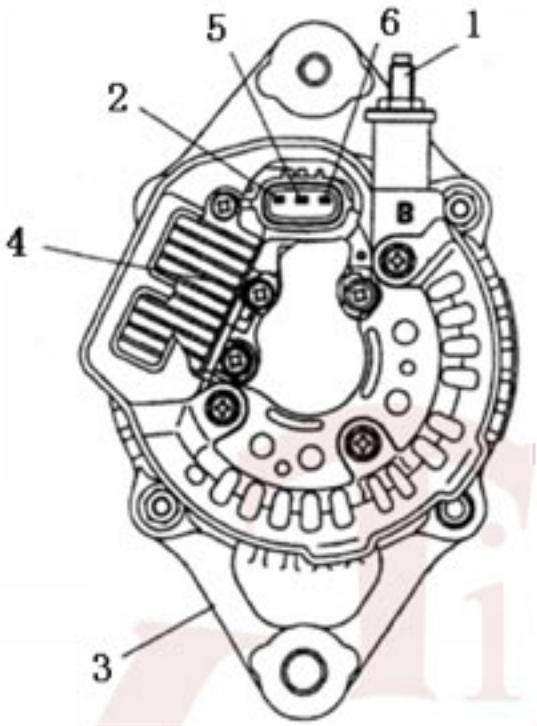


Figure 1.7-5 Wire Connecting Terminal of Alternator

1-Output terminal of generator; 2-Dummy terminal; 3-Earthing; 4-Terminal of field coil; 5-Terminal of ignition; 6-Terminal of charging indicator lamp

1.7.3.4 Disassembly of Alternator

(1) Remove the negative lead of the storage battery.

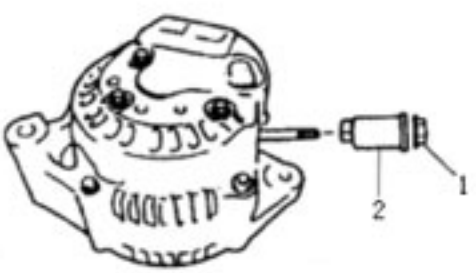
(2) Disassemble the reinforcement of compressor bracket.

(3) Disconnect the connecting lead and connector of the generator.

(4) Remove the connecting bolt of the generator, and then take off the generator assembly.

1.7.3.5 Dismantling of Generator

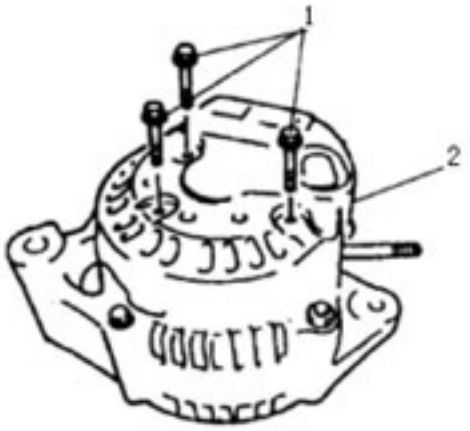
(1) Disassemble the nut of B terminal and insulating part.



1- Inside nut of wiring terminal
2- Insulating part

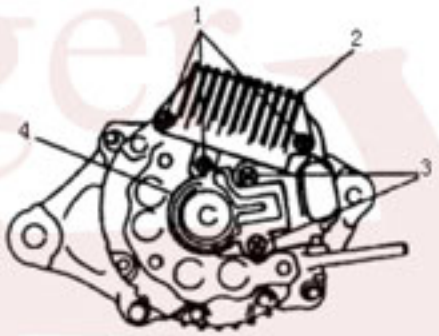
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(2) Disassemble the standing bolt of the back end shield , and then take off the back end cover.



1-Standing bolt 2-Back end cover

(3) Disassemble the fastening screws of brush spacer and integrated circuit regulator, and then take off the brush spacer assembly and integrated circuit regulator.



1-Bolt of integrated circuit regulator; 2-Integrated current regulator; 3-Bolt of brush spacer; 4-Brush spacer assembly

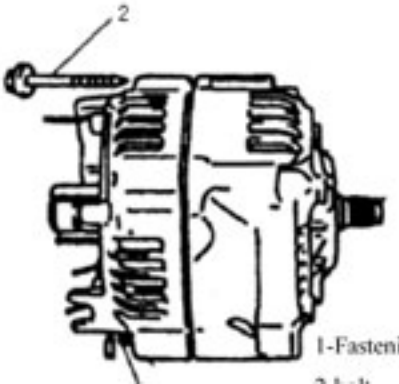
(4) Remove the retaining screw of rectifier spacer, and then take off the rectifier spacer.



1-Fixting bolt; 2-Back end cover

(5) Loosen the nut of the belt pulley, and then remove the belt pulley.

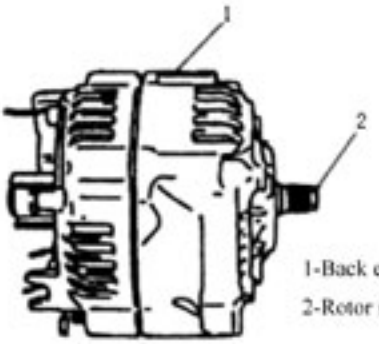
(6) Disassemble the fastening nut and bolt of the back end cover.



1-Fastening nut

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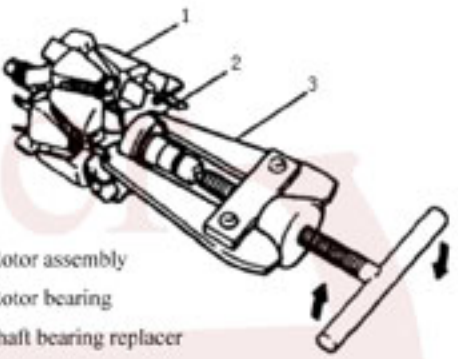
(7) Tap the end cover with plastic hammer, and then disassemble the back end cover and the rotor.



1-Back end cover
2-Rotor shaft

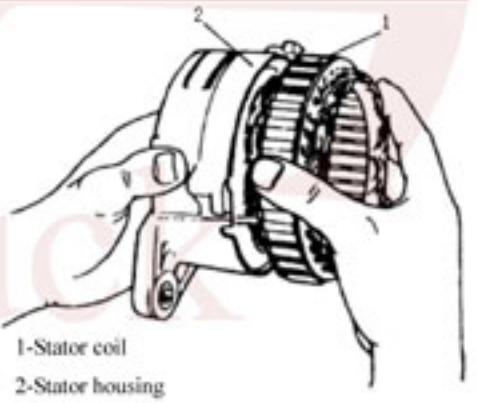
(9) Disassemble the rotor bearing.

(10) Disassemble the fastening bolt of the location-plate, and then take out the bearing of the drive end cover.



1-Rotor assembly
2-Rotor bearing
3-shaft bearing replacer

(11) Screw out the double end stud, and then pull the stator coil out.

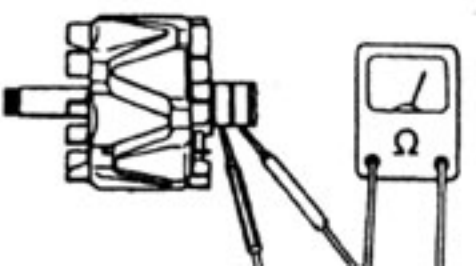


1-Stator coil
2-Stator housing

1.7.3.6 Overhaul of Alternator

(1) Overhaul of Rotor Assembly

1) Interruption Testing for Rotor Coil



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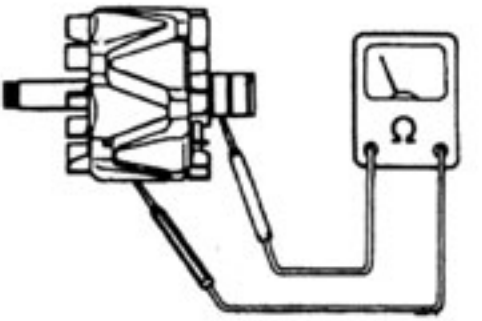
Test the resistance between the two slip rings with the multimeter; replace the rotor assembly if any interruption.

The standard resistance value is about 2.9Ω.

2) Interruption Testing for Rotor Coil

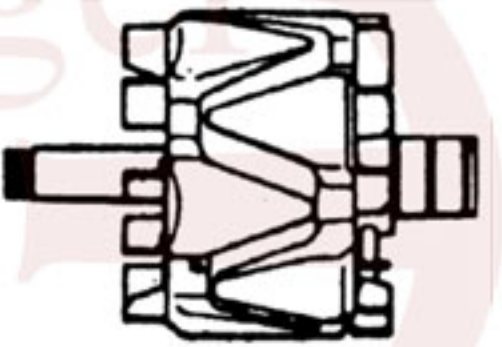
Test the resistance between the slip rings and the claw pole with the multimeter; replace the rotor assembly if it is conducted.

The standard resistance value is ∞Ω.



3) Inspection for surface of slip rings

The surface of the slip rings should be smooth without any scratches; if any scratches or other flaws, the rotor should be replaced.

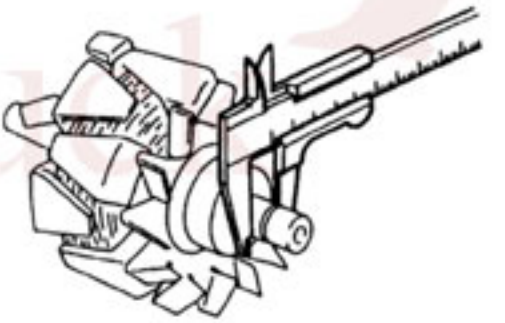


4) Diameter measurement for the slip rings

Measure the diameter of the slip rings with vernier caliper. Replace the rotor if the diameter is smaller than the operating limit.

Standard diameter is 14.4 mm.

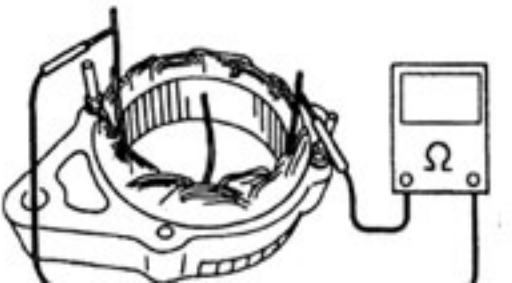
Operating limit is 14.0 mm.



(2) Overhaul of Stator Assembly

1) Interruption Testing for Stator Coil

Test all the leads with the multimeter; replace the stator assembly if any

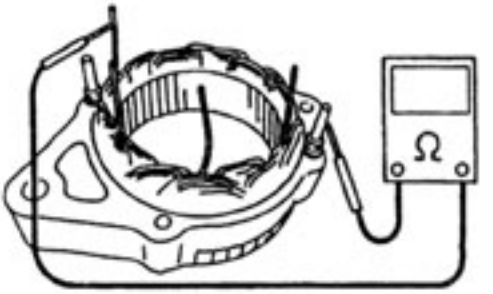


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interruption.

2) Interruption Testing for Stator Coil

Test the resistance between the two leads with the multimeter; replace the stator assembly if any interruption.



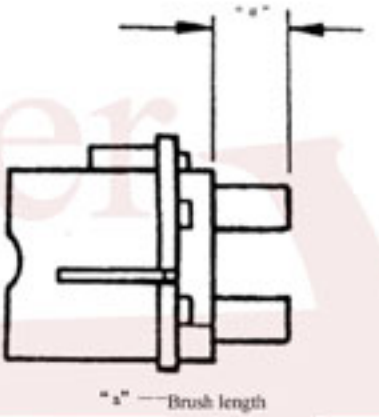
(3) Overhaul of Brush

1) Inspection of the Brush Length

Measure the brush length with caliper; replace the brush if it is worn beyond the operating limit.

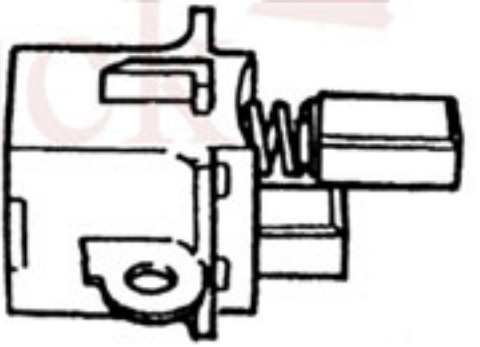
The standard value of the brush length is 10.5mm.

Operating limit is 4.5mm.



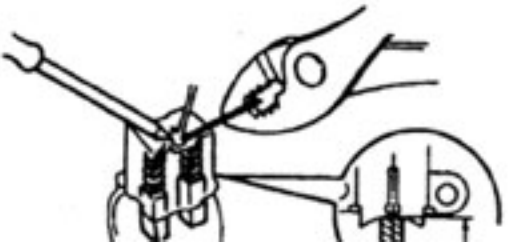
2) Disassembly of the Brush

Loose weld for the brush and connecting lead with brand iron, and then dismantle the brush and the brush spring.



3) Replacement of Brush

Install the brush and spring into the brush rocker, and then braze weld the brush and



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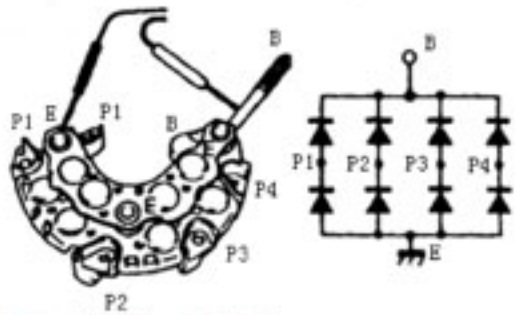
the connecting lead.

Exposed length of brush is 10.5 mm.

(4) Overhaul for Rectifier

1) Inspection of Positive Rectifier

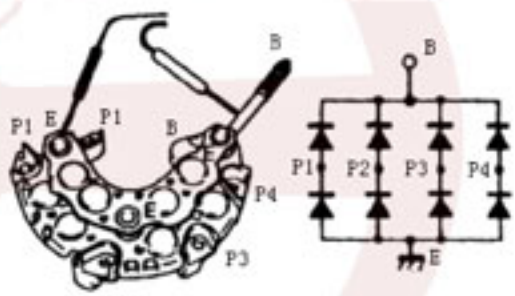
Test the B terminal and P1- P4 terminals of the rectifier with the multimeter.Replace the rectifier spacer assembly if the two directions are conducted.



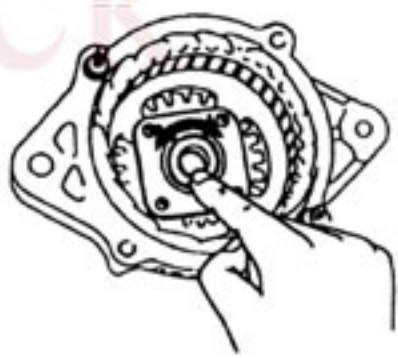
B-Positive terminal
P1-P4- Rectifier terminal

2) Inspection of Negative Rectifier

Test all the negative terminals and P1- P4 terminals of the rectifier with the multimeter.Replace the rectifier spacer assembly if the two directions are conducted.



B-Positive terminal
P1~P4- Rectifier terminal



(5) Overhaul for Bearing

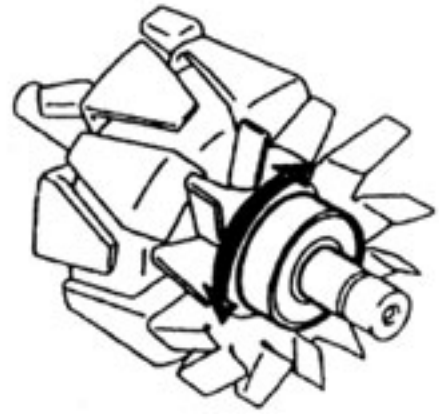
1) Inspection for the Drive End Bearing

Rotate the drive end bearing gently with hand, and check that if the bearing is worn or damaged; replace it if it is undesirable.

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2) Inspection for the Rotor Bearing

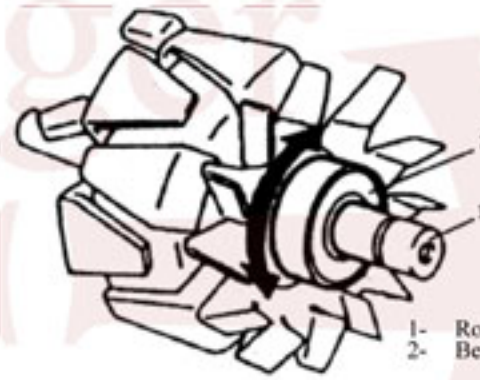
Rotate the bearing gently with hand, and check that if the bearing is worn or damaged; replace it if it is undesirable.



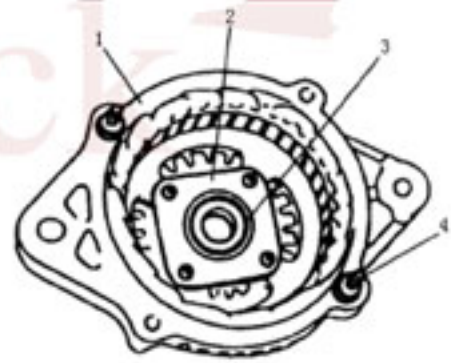
1.7.3.7 Assembly of Alternator

(1) Assembly of the rotor bearing

Mount the rotor bearing on the rotor shaft; keep it rotated smoothly.



1- Rotor shaft
2- Bearing



1-Drive end cover; 2-Retaining plate; 3-Bearing; 4-Upper

(2) Assembly of the drive end bearing

Mount the bearing into the drive end cover; mount the retaining plate; screw the mounting bolt; keep the bearing rotated smoothly.

1-Drive end cover 2-Retaining plate
3-Bearing 4-Double end stud

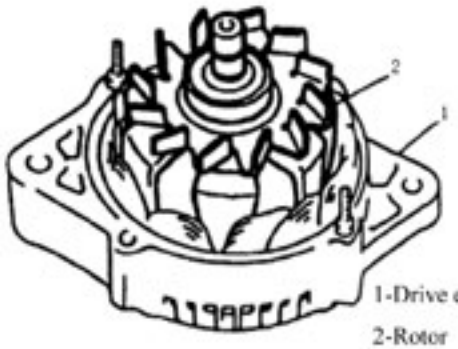
Fastening moment for bolt of retaining plate: 8.8N·m

Fastening moment for double end stud of end cover is 2.6N·m.

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(3) Combined Rotor and Drive End Cover

Put the spacer sleeve and the drive end frame on the belt pulley, and then mount the rotor on the drive end cover.

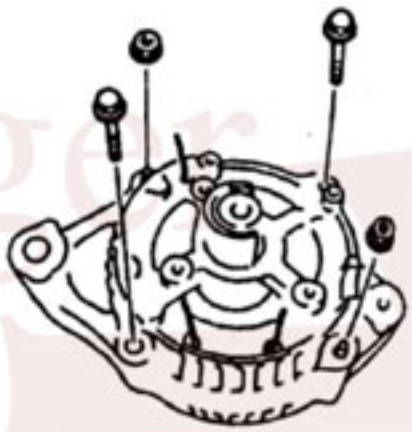


1-Drive end cover
2-Rotor

(4) Assembly of the back end cover

Mount the back end cover onto the drive end cover, and then tighten the mounting bolt and nut.

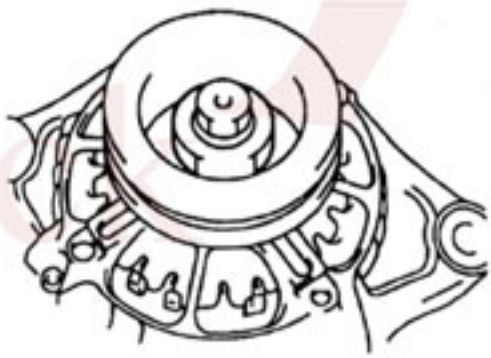
Tightening moment for the bolt and nut: 4.5N·m



(5) Assembly of the Belt Pulley

Mount the belt pulley onto the rotor shaft, and then tighten the nut of the rotor shaft.

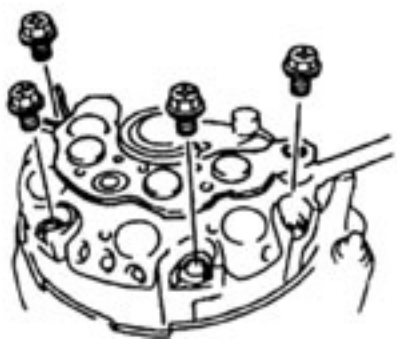
Tightening moment for the bolt and nut: 113N·m



(6) Assembly of Rectifier Spacer

Install the rectifier spacer onto the back end cover, and then tighten the mounting bolt of the spacer. Guarantee that the enough space should be left between the stator coil and the cooling fan blades.

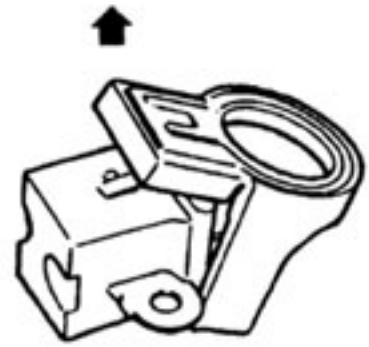
Tightening moment for the bolt: 2N·m



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(7) Assembly of the Brush Spacer

Install the brush spacer onto the back end cover according to the direction shown in the Figure.

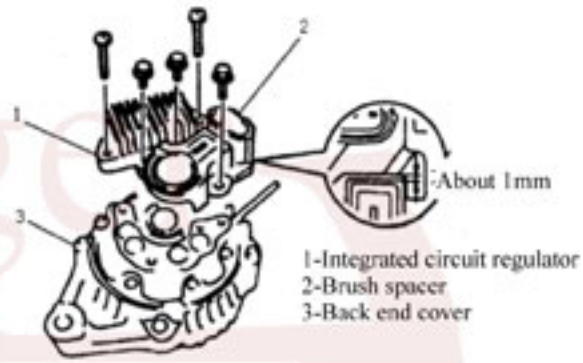


(8) Assembly of the Integrated Circuit Regulator

Put the integrated circuit regulator and the brush spacer on the back end cover horizontally, and then tighten the mounting screw, and keep suitable space between the spacer and the connector lug.

The space between the brush spacer and the connector lug is 1mm.

Tightening moment for the bolt: 2N·m



(9) Assembly of the back end shield

Install the back end shield onto the back end cover, and then tighten the mounting bolt.

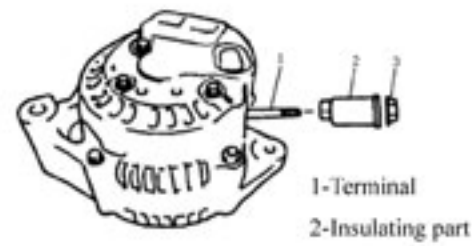
Tightening moment for the bolt: 4.5N·m



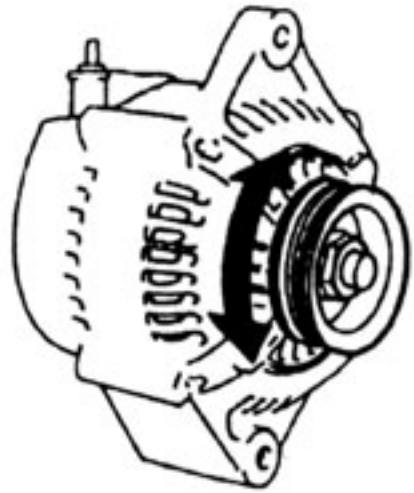
(10) Installation of the insulating part of the terminal

Install the insulator onto the terminal, and then tighten the inside nut.

Tightening moment for the bolt: 8N·m



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(11) Inspection after Assembly of Generator

Keep the rotor rotated smooth after the generator is assembled; readjust it if the rotor rotated abnormal.

1.7.3.8 Installation of Generator Assembly

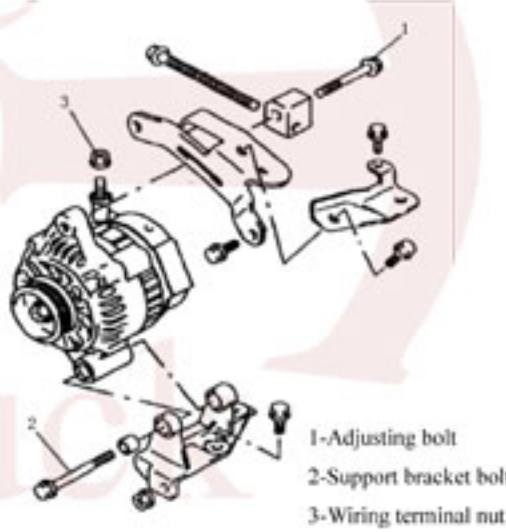
(1) Installation and Assembly of the Generator Assembly

Installation procedure of the generator is contrary to the disassembly procedure. Tighten the bolt and nut according to the specified fastening moment.

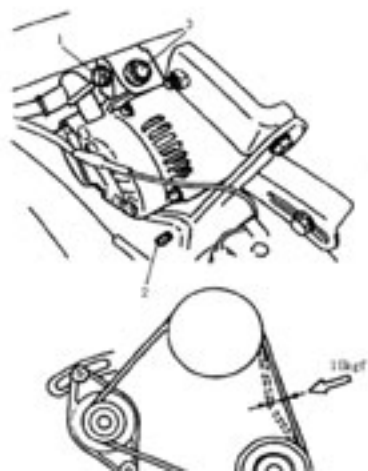
Tightening moment for adjusting bolt: 23N·m

Tightening moment for support bracket bolt: 50N·m

Tightening moment for the nut of terminal: 8N·m.



1-Adjusting bolt
2-Support bracket bolt
3-Wiring terminal nut



(2) Adjustment of Generator Belt

Adjust the tensity of the belt after installation of generator, and then tighten the

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adjusting bolts.

Belt flexivity: 6- 8mm (old belt) or 5- 6mm (new belt)

1.7.3.9 Inspection for Generator

(1) Generator Testing Circuit Diagram (Figure 1.7-6)

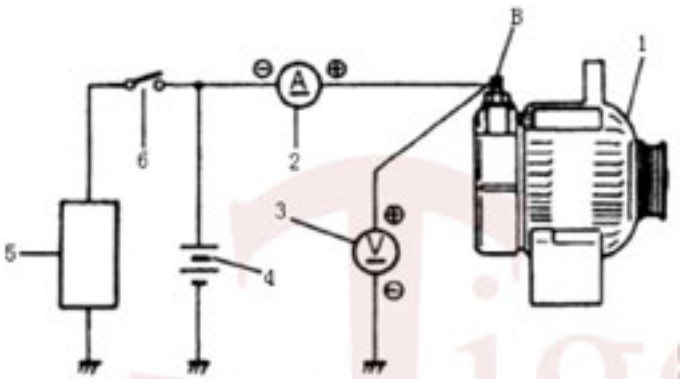


Figure 1.7-6 Generator Testing Circuit Diagram

1-Generator; 2-Ammeter; 3-Voltmeter; 4-Storage battery; 5-Load; 6-Switch

(2) Idle Load Inspection of Generator

Start and idle run the engine at 2000r/min (gasoline engine), then test the output voltage and current.

(3) Fully Load Inspection of Generator

Start and idle run the engine at 2000r/min (gasoline engine), and open the front lamp and the H.V. motor, and then test the output voltage and current.

1.7.4 Voltage Regulator

Integrated circuit regulator:

The integrated circuit regulator is the hybrid integrated circuit regulator which consists of a monolithic integrated circuit and dynatron and so on. Its structure is quite complex; If any failure, it should be replaced. The voltage regulating range of this regulator is 14.4- 15.0V.

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1.8 Intake and Exhaust System

1.8.1 Gasoline engine intake and exhaust system

1.8.1.1 Air intake system

Major components:

Air cleaner, throttle, idle stepping motor air valve and intake manifold etc.

Functions:

Air is filtered by air filter to control engine intake volume through throttle block, and is distributed to all combustion chambers through intake manifold. Idle stepping motor operation is controlled by ECU at idle speed to control air volume. Intake manifold can also provide vacuum negative pressure source for complete vehicle.

General requirement:

An air filter can filter out impurity in air, and guarantee that air flowing into engine is clean to minimize air intake resistance. Throttle should rotate smoothly, and inside of throttle should be clean. Idle stepping motor air valve should be clean without clogging. Intake manifold should have no cracks, no air leakage and no water leakage.

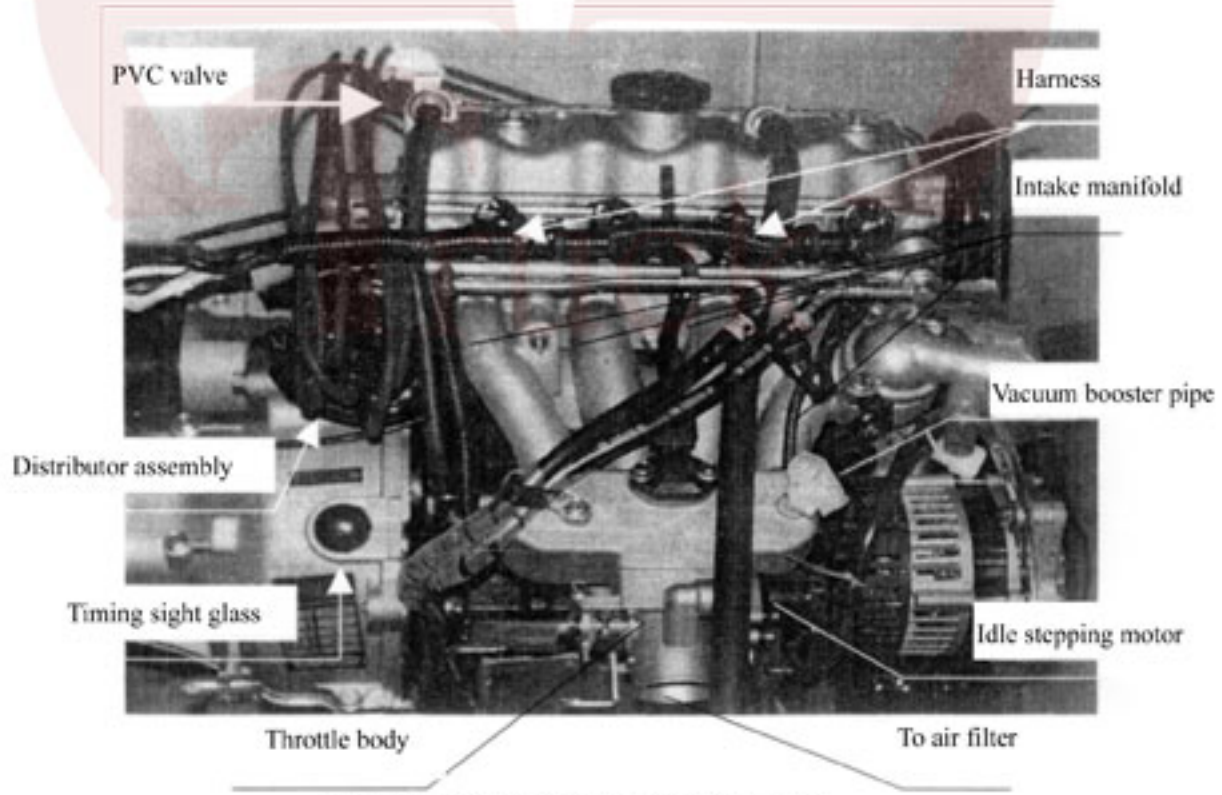
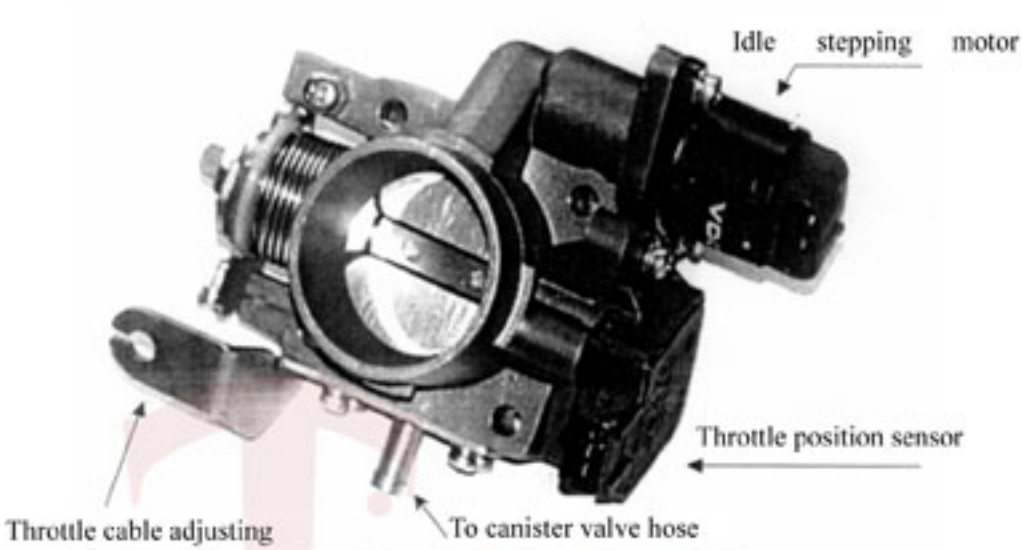


Fig. 1.8-1 Pictorial diagram of gasoline engine

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(1)Throttle body



1) Throttle cabled adjustment

Adjust cable adjusting nut to fully close and open throttle, and take the opening readings of throttle with tester. When throttle is fully closed and opened, readings should be equal to 0 or bigger than 80 degree.

2) Disassembly of throttle body

□ Disassemble cable from throttle body

□ Disassemble electronic connectors of throttle position sensor and idle speed stepping motor.

□ Disassemble air cleaner hose and canister hose from throttle body.

□ Disassemble throttle body from intake manifold.

3) Check whether throttle can rotate freely and smoothly.

4) Installation of throttle

Reassemble throttle in reverse sequence as that for disassembly and good throttle body gasket should be used.

(2) Idle speed stepping motor

1) Disassembly:

□ Disassemble throttle body.

□ Disassemble idle speed stepping motor.

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2) Check:

□ It is clean.

□ Valve head can move smoothly;

□ o-ring is good;

□ Connectors have no deformation and corrosion.

3) Installation:

Good O-ring should be used to install idle speed stepping motor to original position.

Screw torque: 4±0.5Nm

(3) Throttle position sensor

1) Disassembly:

□ Disassemble throttle body.

□ Disassemble throttle position sensor.

2) Check:

□ o-ring is good;

□ Connectors have no deformation and corrosion.

□ Throttle axis is of interference fit.

3) Installation:

Fix to original position, screw torque: 2±0.5Nm

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(4)Intake manifold

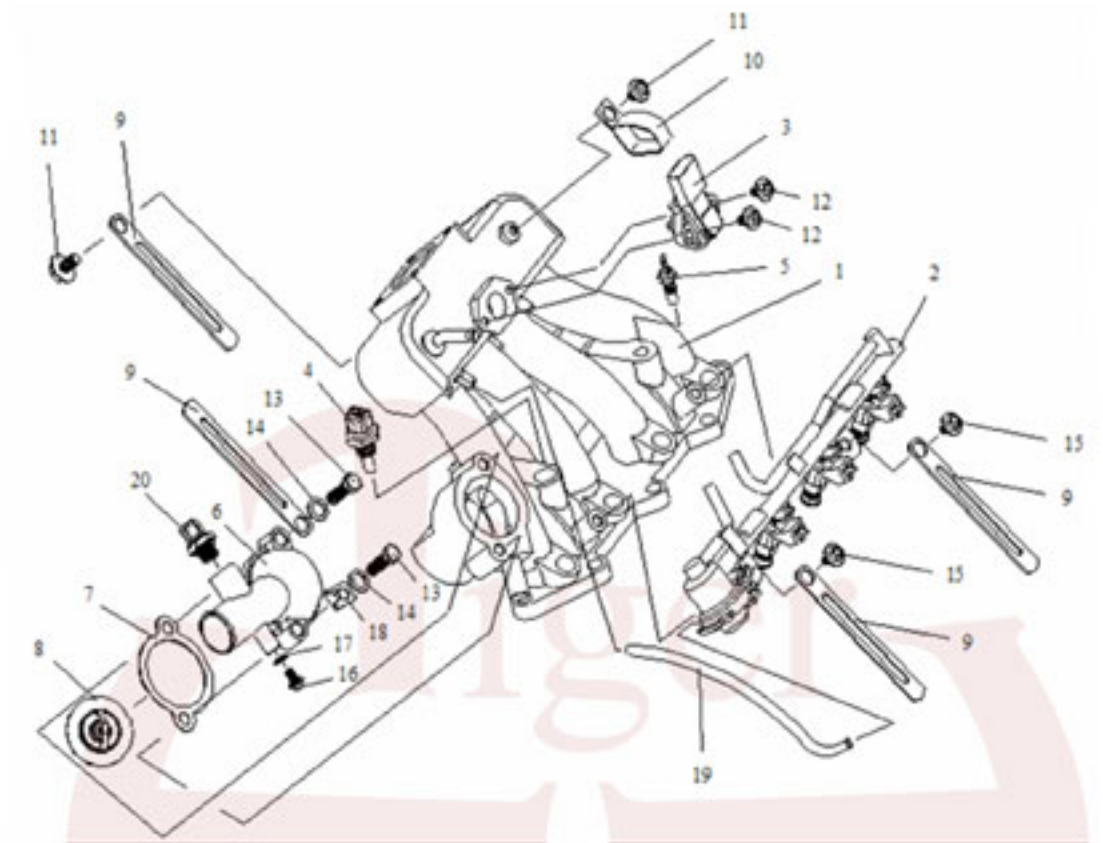


Fig. 1.8-2 Intake manifold

1. Intake manifold assembly; 2. Fuel main assembly; 3. Intake pressure temperature sensor assembly; 4, 5 Water temperature sensor assembly; 6. thermostat cover; 7. Thermostat cover seal; 8. Thermostat assembly; 9. Long supporting piece; 10. Lock pipe bracket; 11.12.13.15. bolts; 14. Washer; 16. Cooling system bleed screw; 17. Cooling system bleed screw washer; 18. Earth lug; 19. Pressure regulator vacuum hose; 20. Cooling fan switch assembly.

1) Intake manifold assembly

Intake manifold assembly as shown in Fig.1.8-2.

2) Inspection of intake manifold

Visual check: check intake manifold surface for any serious deformation, cracks, corrosion or other mechanical damages, and inside of manifold for any scale fouling, repair or replace if necessary.

Inspection of joint faces: check joint between intake manifold and cylinder head for any deformation, and repair if any.

Intake manifold joint face flatness: 0.10mm

3) Inspection of sealing gasket

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Check sealing gasket for any serious deformation, defect and damage, and replace with new sealing gasket if any.

1.8.1.2 Air Exhaust System

Major components:

Activated carbon canister, canister control valve (which is used for processing steam in fuel tank, intake manifold), PCV valve and related pipe lines as well as three-way catalyst etc.

Functions:

To reduce harmful gas emission such as fuel steam, waster gas in crankcase and tail gas.

General requirement:

All parts function well, and piping system well sealed without clogging or leakage.

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(1)Exhaust manifold

1) Exhaust manifold assembly (Fig. 1.8-3)

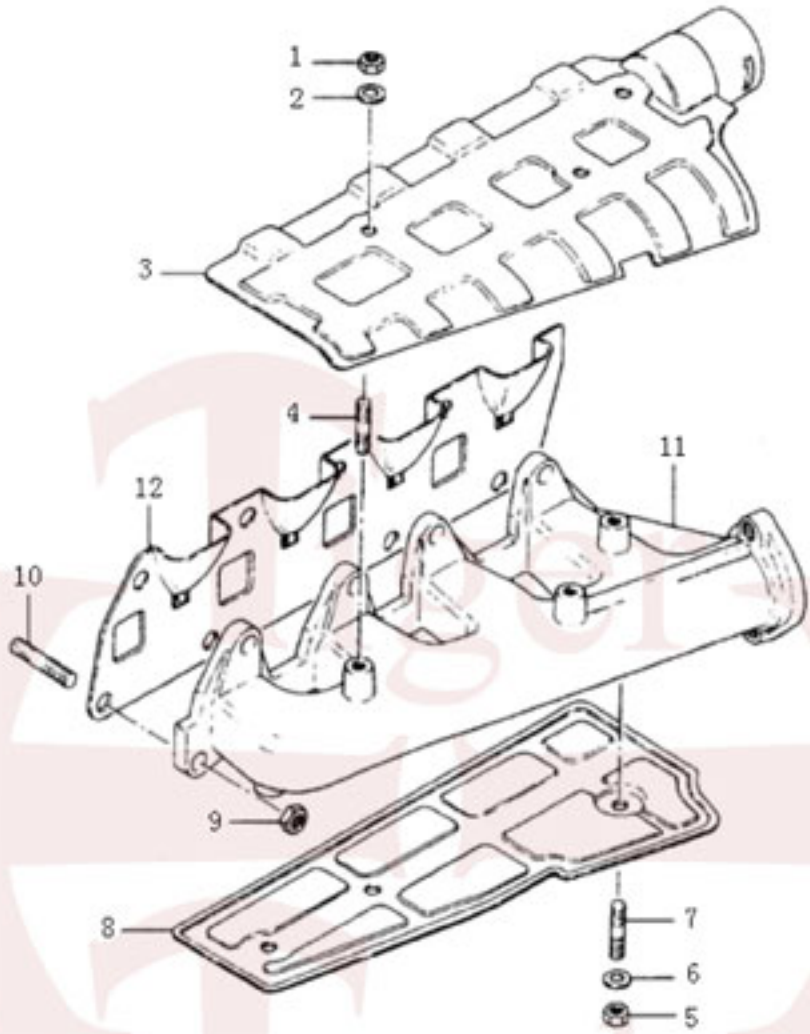
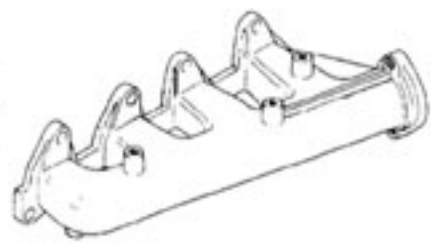


Fig.1.8-3 exhaust pipe assembly

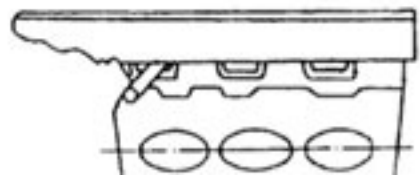
1.5.9. nuts; 2.6.washers; 3. upper cover; 4. stud nut; 7.10. stud; 8. lower cover; 11. exhaust manifold; 12. gasket

2) Inspection of exhaust manifold

Visual check: check exhaust manifold surface for any serious deformation, cracks, corrosion or other mechanical damages, and inside of manifold for any scale fouling, repair or replace if any.



Inspection of joint faces: check joint between exhaust manifold and cylinder head for any

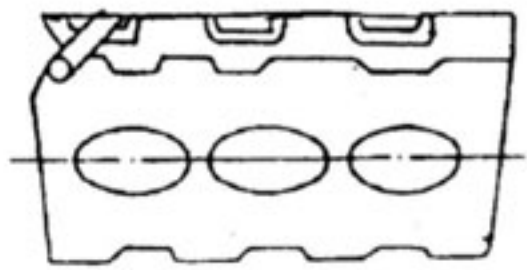


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deformation, and repair if any.

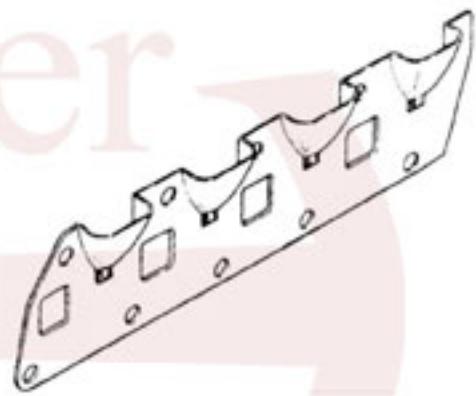
Exhaust manifold joint face flatness: 0.10mm

Carbon inspection of exhaust manifold: check exhaust manifold duct for any carbon, and timely clean it if too much.



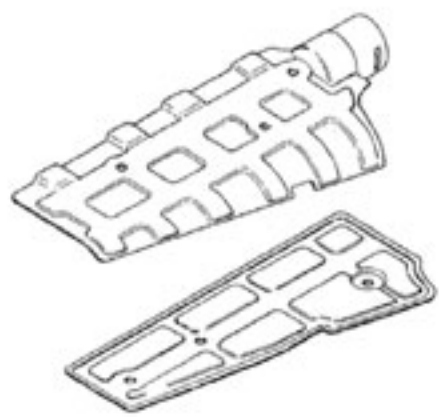
Inspection of heat-insulated sealing gasket

Check heat-insulated sealing gasket for any serious deformation, defect and damage, and replace with new sealing gasket if any.



4) Inspection of exhaust manifold cover

Check exhaust manifold cover for any serious deformation, defect or damage, and repair or replace if any.



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(2) Crankcase forced ventilation system

1) Crankcase forced ventilation system

When engine works, mixed gas that blows into crankcase flows into cylinder through blow-by channel of cylinder block, and oil particles in the blow-by mixed gas are separated by oil separator inside cylinder head cover; then blow-by mixed gas returns to intake manifold through PCV control valve together with fresh air from air filter to be burned again in combustion chamber to reduce ambient pollution.

2) Inspection of crankcase forced ventilation system

Inspection of PCV valve: when engine works, unplug blow-by mixed gas hose from cylinder head cover and close hose inlet with thumb to check whether suction is available. If not, repair crankcase forced ventilation system.

(3) Activated carbon canister storing system

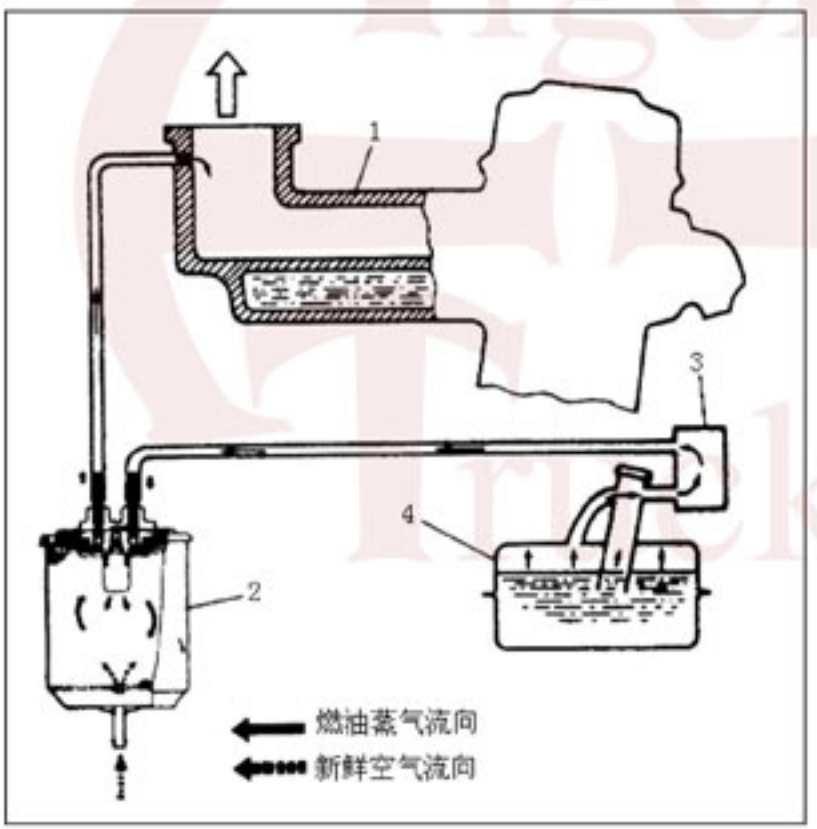


Fig.1.8-4 Activated carbon canister system

1-Intake manifold; 2-Activated carbon canister; 3-Liquid steam separator; 4-Fuel tank

1) Schematic plan of activated carbon canister system (Fig.1.8-4)

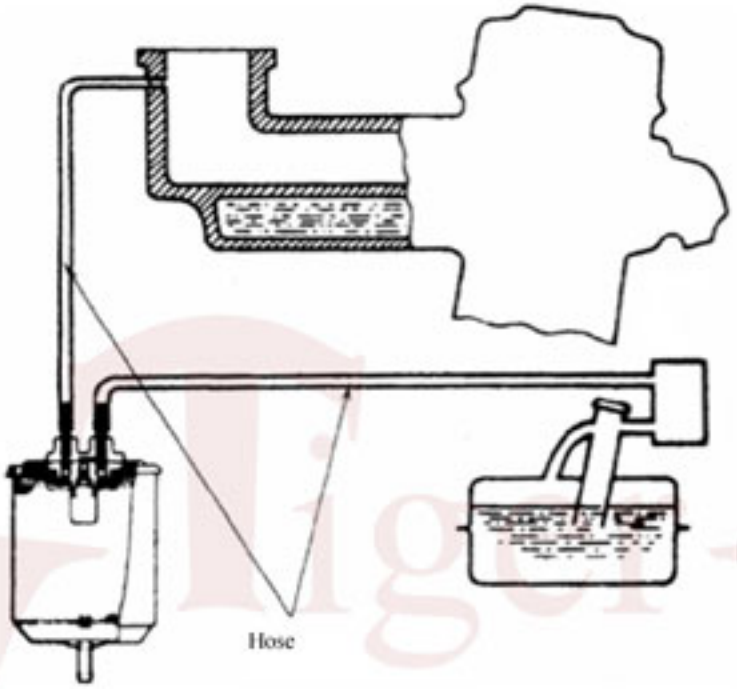
The function of activated carbon canister storing system is to reduce harmful gas in ambient from fuel evaporator and guide fuel vapor produced in fuel tank to activated carbon canister to be absorbed and stored by activated carbon canister when vehicle is running or engine stops. When engine works, fuel vapor stored in activated carbon canister is guided into intake manifold together with fresh air to be burn in cylinder.

2) Inspection of activated carbon canister storing system

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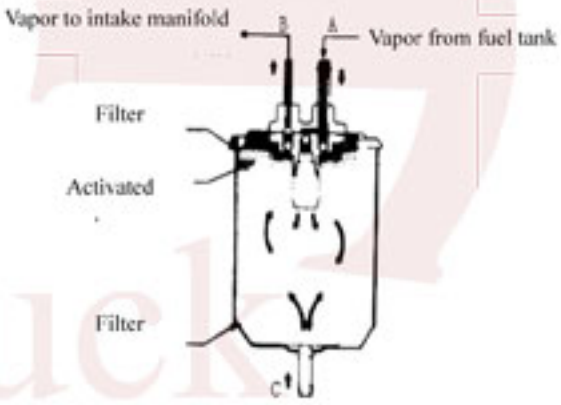
Inspection of hose connection

Check hose connections for any cranks, damages or over bending, and clamping bands for any looseness, repair or replace if any.



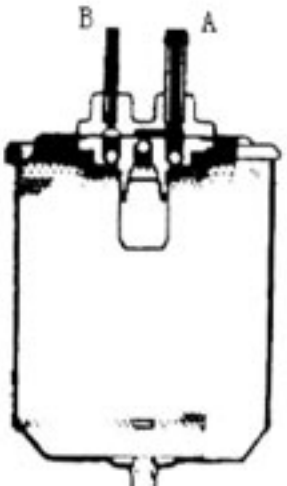
Inspection of activated carbon canister:

Remove connecting hose of activated carbon canister, and blow in air from hose A; air should freely go through hose B, C; without any restriction; when air is blown in from hose B, air should not be able to flow through hose A or C. Otherwise, canister should be replaced.



Cleaning of activated carbon canister:

Close canister hose B, and use suction tube A of compressed air of 3kgf/cm^2 to purge canister.



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1.8.2 Intake and Exhaust System of Diesel Engine

1.8.2.1 Intake system

(1) Intake manifold assembly (Fig. 1.8-5)

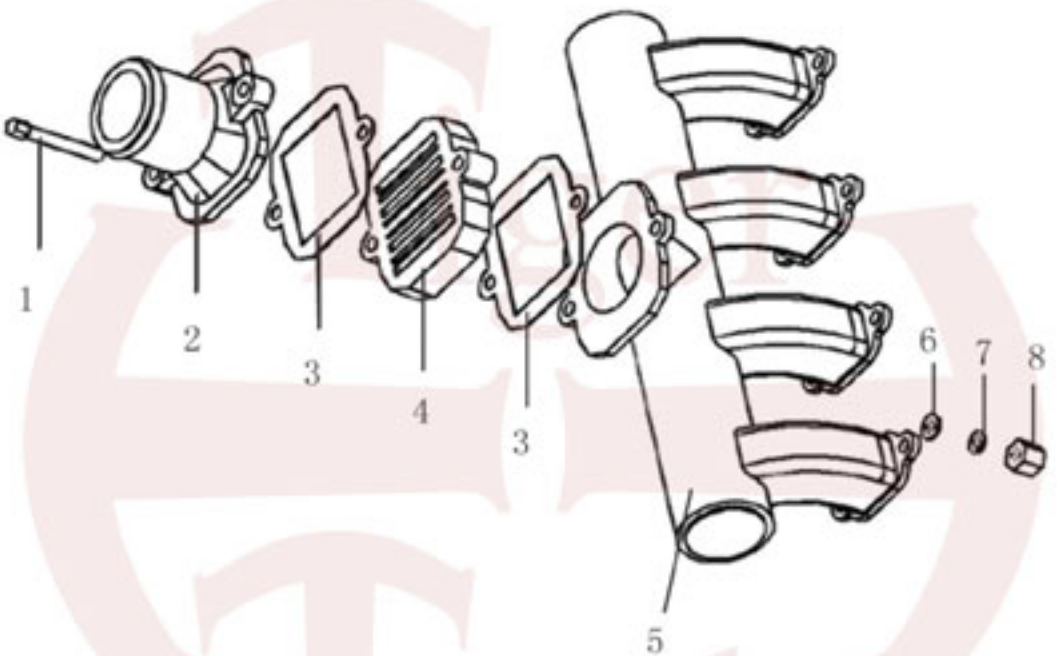


Fig. 1.8-5 Intake manifold assembly

1-Bolt; 2-Intake connector; 3-Intake elbow gasket; 4-Electric heater parts; 5-Main; 6, 7-Washer; 8-Nut

(2) Inspection of intake manifold

Check intake manifold surface for any serious deformation, cracks, corrosion or other mechanical damage, and manifold for any scale fouling, repair or replace if any.

(3) Inspection of joining face

Check joint between intake manifold and cylinder head for any deformation, repair if any.

Intake manifold joint flatness: 0.10mm

(4) Inspection of gasket

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Check gasket for any serious deformation, defect or damage, and replace with new gasket if any (Whether gasket must be replaced each time it is removed.)

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1.8.2.2 Exhaust system

(1) Exhaust manifold assembly (Fig. 1.8-6)

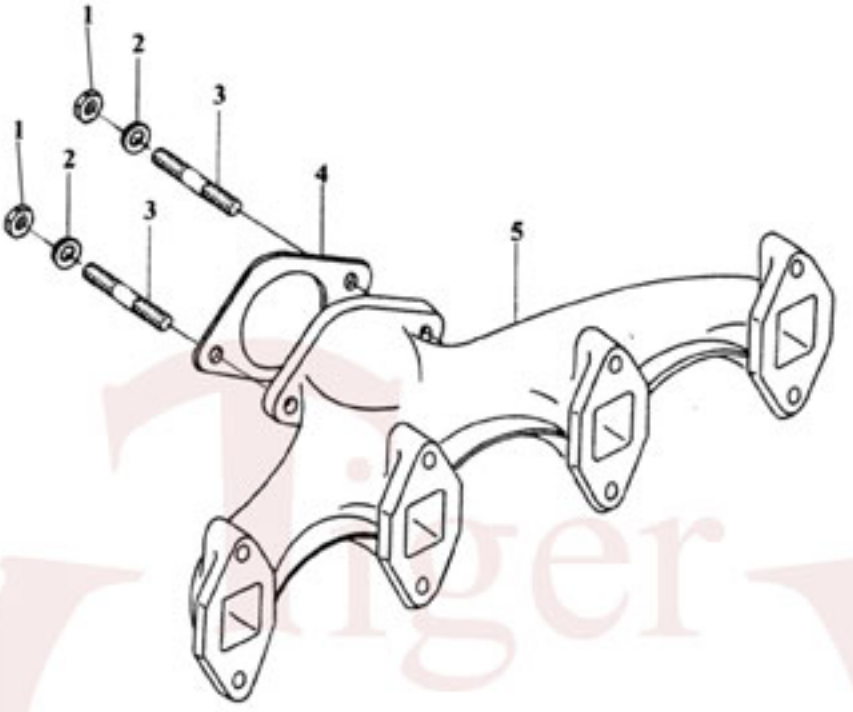


Fig. 1.8-6 Exhaust manifold assembly

1. copper nut; 2. washer; 3. stud; 4. exhaust manifold gasket; 5. exhaust pipe

(2) Inspection of exhaust manifold

Visual check: check exhaust manifold surface for any serious deformation, cracks, corrosion or other mechanical damage, and manifold for any scale fouling, repair or replace if any.

Inspection of joining face: check joint between exhaust manifold and cylinder head for any deformation, repair if any.

Exhaust manifold joint flatness: 0.10mm

Inspection of exhaust manifold carbon: check exhaust manifold bleed hole for any carbon, clean it if too much.

(3) Inspection of sealing heat-insulated gasket

Check gasket for any serious deformation, defect or damage, and replace it with new gasket if any. (Whether gasket must be replaced each time it is removed.)

(4) Inspection of exhaust manifold cover

Check exhaust manifold cover for any serious deformation, defects or damages, repair or replace it if any.

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1.9. Electronic Control System (for Gasoline Engine)

1.9.1. General of Electronic Control System

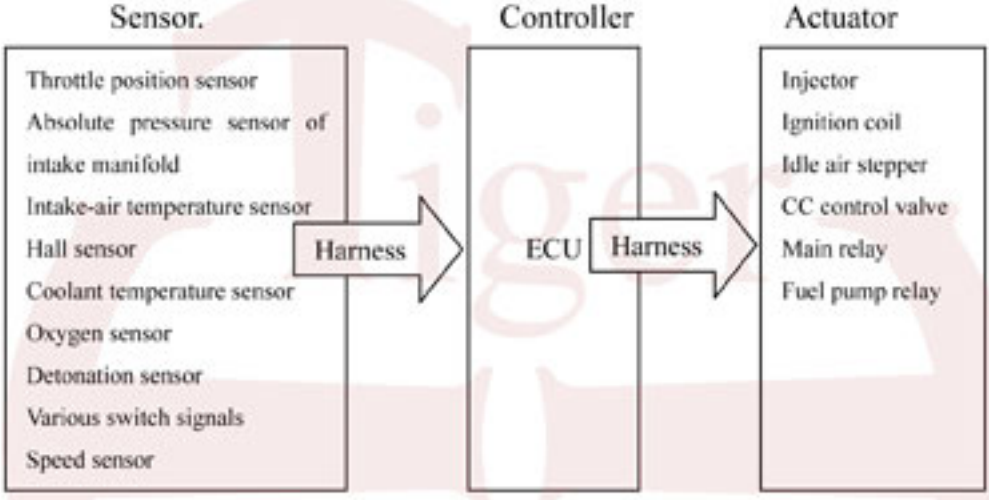
It mainly consists of:

(1). Various sensors that can detect engine conditions, operating mode and other necessary information;

(2). Electronic Control Unit (ECU) that can analyze and process output signals from sensors and control operation of various actuators;

(3). Various controlled devices, i.e. actuators;

(4). Electric harness that links various sensors, ECU and actuators.



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List of input/output signal relations of engine electronic control system

Input \ Output	Actuator					
	Injector	Ignition coil	Idle air stepper	CC control valve	Main relay	Fuel pump relay
Throttle position sensor	○	○	○	○		
Absolute pressure sensor of intake manifold	○	○	○	○		
Intake-air temperature sensor	○	○	○			
Hall sensor	○	○	○	○		○
Coolant temperature sensor	○	○	○	○		
Oxygen sensor	○					
Detonation sensor	○	○				
Speed sensor			○			
Strengthened earth line 1	○					
Strengthened earth line 2	○					
Ignition correction earth line		○				
Ignition switch	○	○	○	○	○	○

1.9.1.1. Throttle position sensor

Function:

Provide engine load and operating information.

Principle:

The sensor is actually a steering angle potentiometer with linear output. Potentiometer arm and throttle are assembled in the same axle. When the throttle turns, the potentiometer arm will slide in certain resistance position; the potentiometer will output voltage signals corresponding to the throttle position.



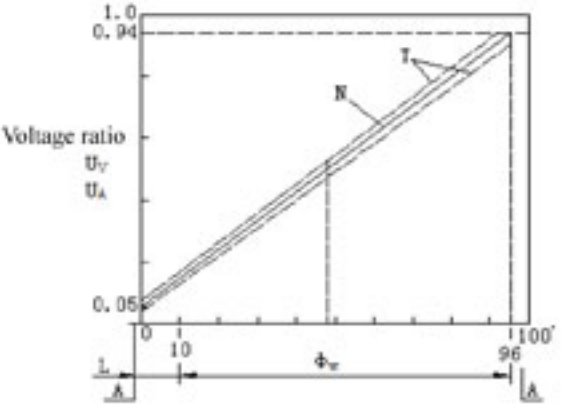
Characteristic curve

U_A: output signal voltage

U_V: operating voltage

N: Theoretic characteristic curve

T: Characteristic curve tolerance



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Technical parameters:

Electronic angle range	≤96°
Steering direction	Any
Resistance	2kΩ+20%
Operating voltage	5V
Operating temperature	-30□-+110□, -40□-+120□(for short time)
Arm protection resistance	710Ω-1380Ω
Arm allowable current	≤18 μ A
Product service life	2000000 circulation

General requirements:

Output signal corresponds to the throttle opening, preventing water and collision; connectors are required clean, no distortion and corrosion, with good appearance.

1.9.1.2. Intake-air pressure and temperature sensor

Function:

Measure absolute pressure of intake manifold and provide engine load information.

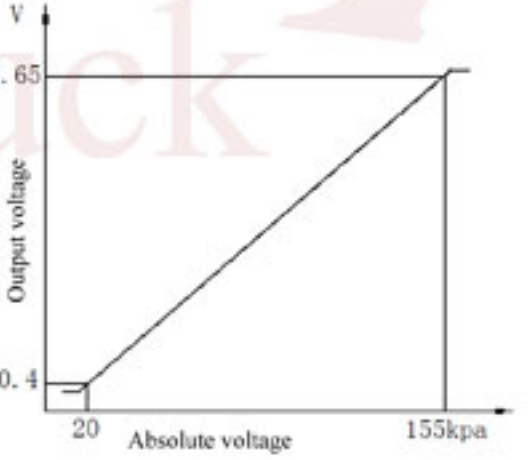


Principle:

A sensing element consists of a silicon chip. Etch pressure diaphragm in the silicon chip, and gather the rating and rectification circuit in the silicon chip. Change of air pressure makes the diaphragm distorting; piezoresistive effect changes resistance; after processed by the chip, it forms voltage signal that has linear relation with voltage. The sensor is directly installed in the intake manifold; DS-S/TF model combines pressure sensor with air temperature sensor.

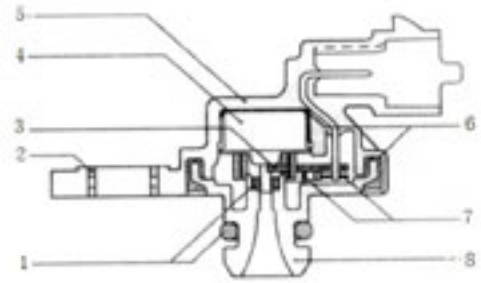
Characteristics: light weight, compact structure; adopt advanced electronic sensing technology; occupy a little of space of intake pipe.

Characteristic curve of pressure sensor



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Sectional drawing of pressure sensor DS-S



1- Seal ring; 2-SS bush; 3-PCB plate; 4-Sensing element; 5-Housing; 6-Pressure bracket; 7-Welding connection; 8-Cementing connection

Pressure range	25kpa-115kpa
Input voltage	5.0±0.5V
Weight	About 18g-27g
Vibration resistance	Harmonic wave: 250m/ s^2 Peak value: 600 m/ s^2
Current	9mA
Temperature sensor resistance at 20□	2.5kΩ±5%
Operating temperature range	-40□-+125□
Trigger time	0.2ms
Pressure measuring tolerance	±1.5%

Technical parameters

1.9.1.3. Hall sensor (installed in a distributor)

Function:

Provide engine speed and crankshaft phase signals for ECU to determine reference time of injection and ignition time.



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Technical parameters:

Supply voltage within the following temperature range:	
-40□-+80□	4.5V-30V
-40□-+150□	4.5V-24V
Supply voltage at UV=16V	≤21mA
Output voltage at UV=20V	0-UV
Output current	0-20mA
Output saturation voltage	≤0.4V
On-off time at output voltage=10%-90%	9φs
Operating ambient temperature	-40□-+130□
Short-time limit temperature	-40□-+150□

General requirements:

Connectors shall e clean, without distortion and corrosion and with good appearance.

1.9.1.4. Coolant temperature sensor



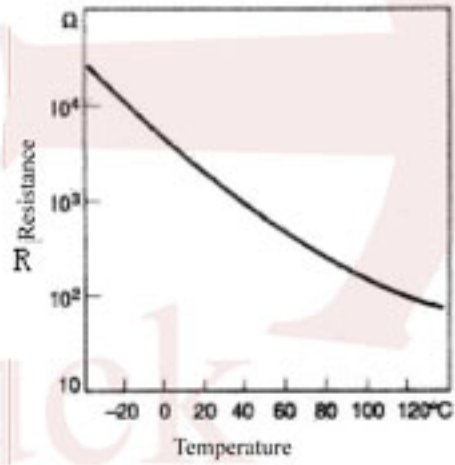
Function:

Measure coolant or intake-air temperature of engine.

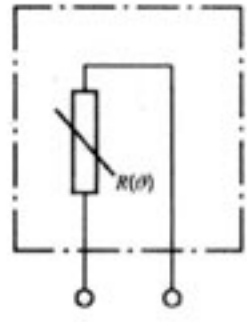
Principle:

The higher the temperature is, the smaller the NTC thermal resistance is in the sensor. Change of coolant or intake-air temperature results in change of resistance; then it will be converted by a distribution circuit as voltage signals into an electronic controller.

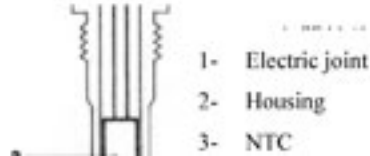
Characteristic curve:



Circuit diagram:



Structural diagram:



Technical parameters (TF-W):

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Measuring range	-30□-+130□
Max. measuring current through the sensor	5mA
Nominal resistance at 20□	2.5kΩ±5%
Max. energy loss at 20□ still water and □T=1K	15mW
Nominal voltage	5V
Vibration resistance	600 m/ s^2
Underwater response time	About 15s

General requirements:

Connectors shall e clean, without distortion and corrosion and with good appearance.

1.9.1.5. Oxygen sensor

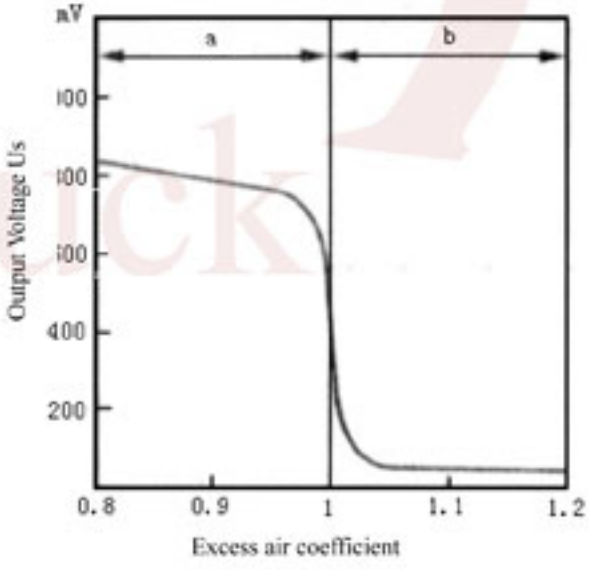
Function:

Measure oxygen content in engine exhaust gas, and ensure whether gasoline and air are consumed fully. According to this information, the electronic controller makes closed loop control targeting at excess air coefficient of λ=1, to ensure that three way catalytic converter can fulfill maximum conversion efficiency towards HC, CO and NOX in exhaust gas.



Principle:

Sensing element of oxygen sensor is a ceramic tube, with the outside to exhaust gas and the inside to ambient air. The ceramic tube is solid electrolyte, utilizing catalyst on the outside of the tube to result in chemical reaction of various components of exhaust gas; oxygen ion can diffuse through the tube, causing electric potential difference between outside and inside of the tube, i.e. signal voltage; the voltage corresponds to oxygen content.



Characteristics:

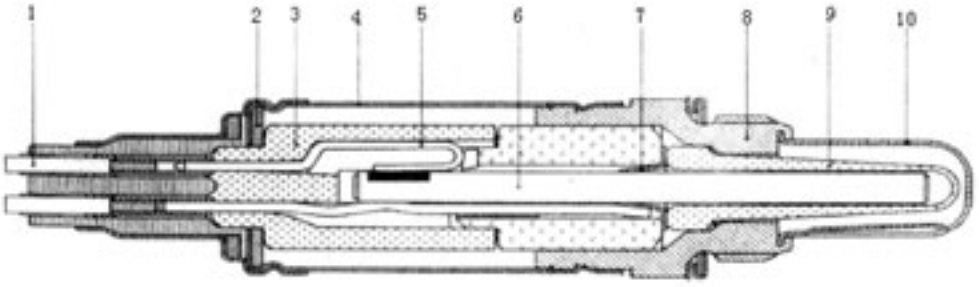
Resist lead; not depend on exhaust gas temperature; enter closed loop control immediately after starting.

Voltage characteristics of oxygen sensor at exhaust temperature = 600□:

a. Dense mixed gas (lack of oxygen);

b. Scarce mixed gas (excess of oxygen).

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1-Cables; 2-Disk gasket; 3-Lower isolation bush; 4-Protection sleeve; 5-Contact metal wire; 6-Heating rod; 7-Contact gasket; 8-Sensor seat; 9-Ceramic probe; 10-Protection sleeve

Technical parameters:

Tightening torque	40Nm-60Nm
Protection sleeve	3 grooves
Operating temperature:	
Ceramic probe (exhaust gas)	200□-850□
Hexagon nut	-570□
Cable outlet	-250□
Connector	-120□
Temperature gradient in ceramic probe	Max. 100k/s
Service life	>160000km

General requirements:

Good appearance, no collision and beating marks; connectors are clean, without distortion and corrosion; cables have no damage and cannot make abnormal noises while shaking; prevent oil from end of the oxygen sensor.



1.9.1.6. Detonation sensor

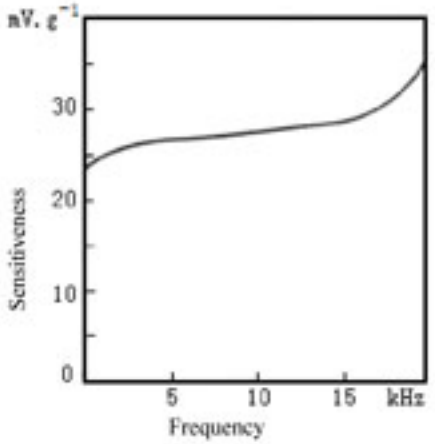
Function:

Detect vibration of engine cylinder so that the electronic controller can identify operating conditions of engine detonation.

Principle:

The detonation sensor is a vibration acceleration sensor. One or more can be installed in the cylinder body of engine. Sensing element of the sensor is a piezoelectric crystal; during detonation of the engine, vibration of the engine will pass through the block in the sensor into the crystal. The piezoelectric crystal produces voltage in two polar faces due to pressure caused by vibration of the block, converting the vibration into output voltage signal.

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Characteristics:
Firm and compact structure; high sensitiveness for measuring.

Technical parameters:

Frequency range	40Nm-20kHz
Measuring range	0.1g-400g
Sensitiveness at 5kHz	26±8mV/g
Linearity at 3-15kHz	±15% of 5kHz
Main harmonic frequency	>20kHz
Resistance	>1MΩ
Capacitance range	800-1600pF
Temperature coefficient of sensitiveness	≤0.06mV/（g.□）
Operating temperature	-40□-+130□

g=9.8m/s^2 (gravity acceleration)

General requirements:
Not beat, with good appearance; cables have no damage; connectors have no distortion and corrosion.

1.9.1.7. Speed sensor
Function:
Install in the speedometer to provide speed signals to ECU for accurately determine operating conditions of engine idling.
General requirements:
Cables are in good conditions; connectors have no distortion and corrosion.
1.9.1.8. Strengthened earth line
Pin 52 of ECU (green wire);
Function:
It is the round connector around the member. Link it with the ground; ECU will automatically strengthen mixed gas to provide sufficient power for the vehicle in plateau areas with scarce air.
General requirements:
The earth line shall be suspended during non operation; otherwise it will increase fuel consumption and exhaust gas.

1.9.1.9. Ignition correction earth line
Function:
It is the square connector together with the strengthened earth line. It must be linked

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with the ground when adjusting ignition timing with the ignition timing lamp. After ECU fastens the ignition advanced angle, the ignition timing can be adjusted.

General requirements:

The line must be suspended after adjusting the ignition advanced angle; otherwise problems may occur, such as inadequate power and too hot three-way catalyzer.

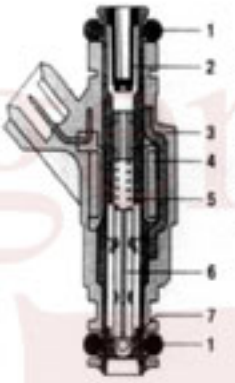
1.9.1.10. Controller ECU

Function:

Analyze and process input signals from sensors, and then send corresponding commands to actuators.

General requirements:

ECU cannot be knocked, collided and wet out; connectors shall be clean, without corrosion, preventing from too high temperature; ECU's lead pin cannot be touched by hand.



1. O-ring
2. Screen
3. Injector with eclectic connector
4. Coil
5. Spring
6. Valve needle with coil armature
7. Valve seat with orifice plate

1.9.1.11. Fuel injector

Function:

Inject certain fuel into intake valve as per the command of ECU.

General requirements:

Atomized fuel spray injected has good shape; injecting hole is not blocked; O-ring is sealed closely; electric connectors are clean with good contact.

1.9.1.12. Ignition coil

Function:

Produce high voltage required for mixed gas ignition to help spark plug igniting mixed gas in the cylinder at appropriate time.

General requirements:

Output high voltage with sufficient power; clean connectors with good contract, preventing from dust and water.



1.9.1.13. Idle air stepper

Function:

Control bypass air input as per the command current sent by ECU to adjust the engine idle and operation.

General requirements:

Clean appearance, no oil or dust, flexible operation; clean connectors with good contact, preventing from water.



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1.9.1.14. Main relay and fuel pump relay

Function:

Turn on or turn off power supply of corresponding apparatus as per the command of ECU.

General requirements:

Clean appearance, flexible operation; no corrosion in connectors, preventing from water.



1.9.1.15. CC control valve

Function:

Control flow of regeneration gas in the evaporation exhaust control system.

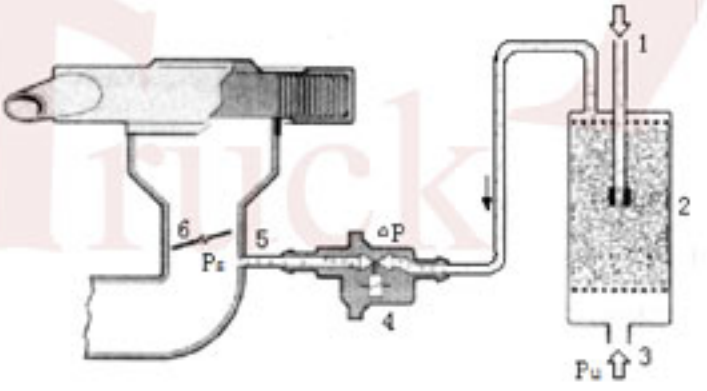
Principle:



CC of the evaporation exhaust control system absorbs oil vapor from the fuel tank until saturation. The electronic controller controls opening of the CC control valve, in order to mix fresh air and saturated oil vapor in CC to form regeneration gas. Lead in intake pipe of the engine again. A magnetic coil is set in the valve; according to different operating conditions, the electronic controller changes duty ratio of pulse signal of magnetic coil to change the valve opening. In addition, the valve opening is also affected by pressure difference at both ends of the valve.

Characteristics:

Wide operating range; accurate flow control; good sealing of valve.



1-From fuel tank; 2-Carbonizer; 3-Air; 4-Caarbonizer control valve; 5-To air intake manifold; 6-Throttle valve

Operating schematic diagram:

ΔP is the difference between environmental pressure Pu and the pressure

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Technical parameters:

Flow	2 or 3 m^2 /h at pressure = 200mbar
Impermeability	<2000 cm^3 /h
Controlling frequency	30Hz
Min. controlling pulse	7ms
Current consumption	0.5A at voltage = 13.5V
Resistance	26Ω
Operating voltage	9V-16V
Inductance	48mH at F=1kHz
Operating temperature	-30□-+120□

General requirements:

Connectors are in good conditions, with good contract, without gas leakage dirt blocking inside.

1.9.2. Troubleshooting

General:

Controller ECU of engine electronic control system is equipped with a failure memory; during operation, ECU makes continuous diagnosis towards parts and operating conditions involved in the system; once abnormal conditions are found, corresponding failures or errors shall be stored in the manner of different codes into the failure memory for reading while troubleshooting; maintenance personnel can utilize failure attention box provided by ECU to immediately and easily clear failures.

If failures are caused by breakage or bad contact of temporary cables, they will be stored as random failures. If the failure does not occur during 40 starting operations of the engine, the failure will be cleared from the failure memory by ECU.

For a failure involved with adjusting error of air-fuel ratio, make commissioning at least for 4 minutes and then read existence of the failure.

If the controller is disconnected, e.g. to pull out the controller plug or remove wire from the battery terminal, the failure information stored in ECU will be cleared.

Note:

(1). First read various information of failures stored in ECU before cutting off power supply of ECU in a vehicle during maintenance;

(2). Clear the failure information stored in ECU, make commissioning, read new failure information, check repeated failure(s) and repair if necessary;

(3). Failure diagnosis meter only can clear failure information stored in ECU, but cannot eliminate failures.

1.9.2.1. Reading and clearing of self-diagnostic failure information in ECU

Failure diagnosis meter for Electronic Fuel Injection System, recommended by the manufacturer, shall be used for reading and clearing of self-diagnostic failure



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information stored in ECU; failure diagnosis interface is under the dashboard (474) and the driver seat (465); joint with three-way jack of the failure diagnosis meter and turn on ignition switch, so as to read and clear failure information in ECU.

Note: Preferably commission to read accurate failure information in ECU.

(1) Time for commissioning is at least 4 minutes;

(2) Commission for 3 minutes when temperature of cooling water is above 70□;

(3) During commissioning, the engine must run for 20s with speed of over 2500r/min;

(4) Run for 10s when the throttle opening is over 75°;

(5) Run in idle for 30s before engine off.

1.9.2.2. Reading for parameters of engine state

Failure diagnosis meter for Electronic Fuel Injection System, recommended by the manufacturer, shall be utilized to read operating parameter during engine running, such as speed and temperature; these parameters can help maintenance personnel to determine failures and repair vehicles.

Note:

Turn on the ignition switch after linking the failure diagnosis meter with the electronic injection system; press reset key of the failure diagnosis meter if it has no response for a long time.

1.9.2.3. Diagnosis of connectors and harness

There are four failure modes for connectors and harness:

(1) Open circuit, i.e. bad contact or disconnection of circuit;

(2) Short to positive pole of power supply, i.e. circuit that should not connect to positive pole of power supply actually connect to the positive pole;

(3) Short to negative pole of power supply, i.e. circuit that should not connect to negative pole of power supply actually connect to the negative pole;

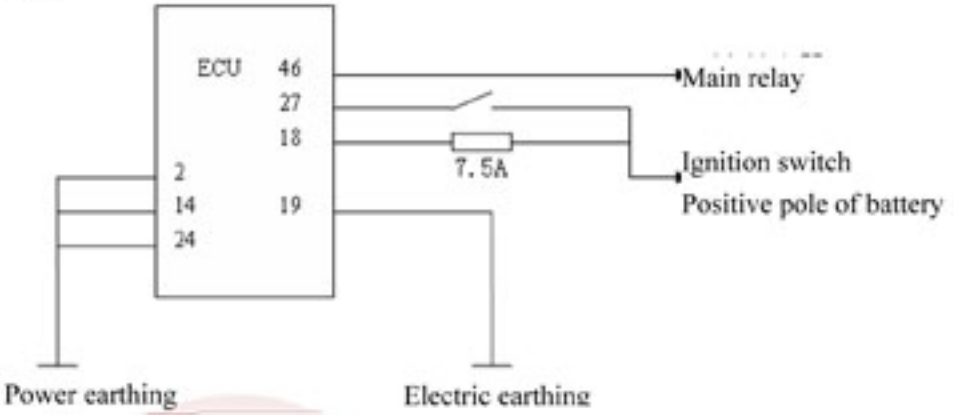
(4) Short to other circuits, i.e. connection or electricity leakage among independent circuits.

If the said failures above are found during diagnosis, make maintenance as per service requirements of electric lines, make the lines fully contact, isolate adjacent lines, and make damp-proof and antiseptic treatments.

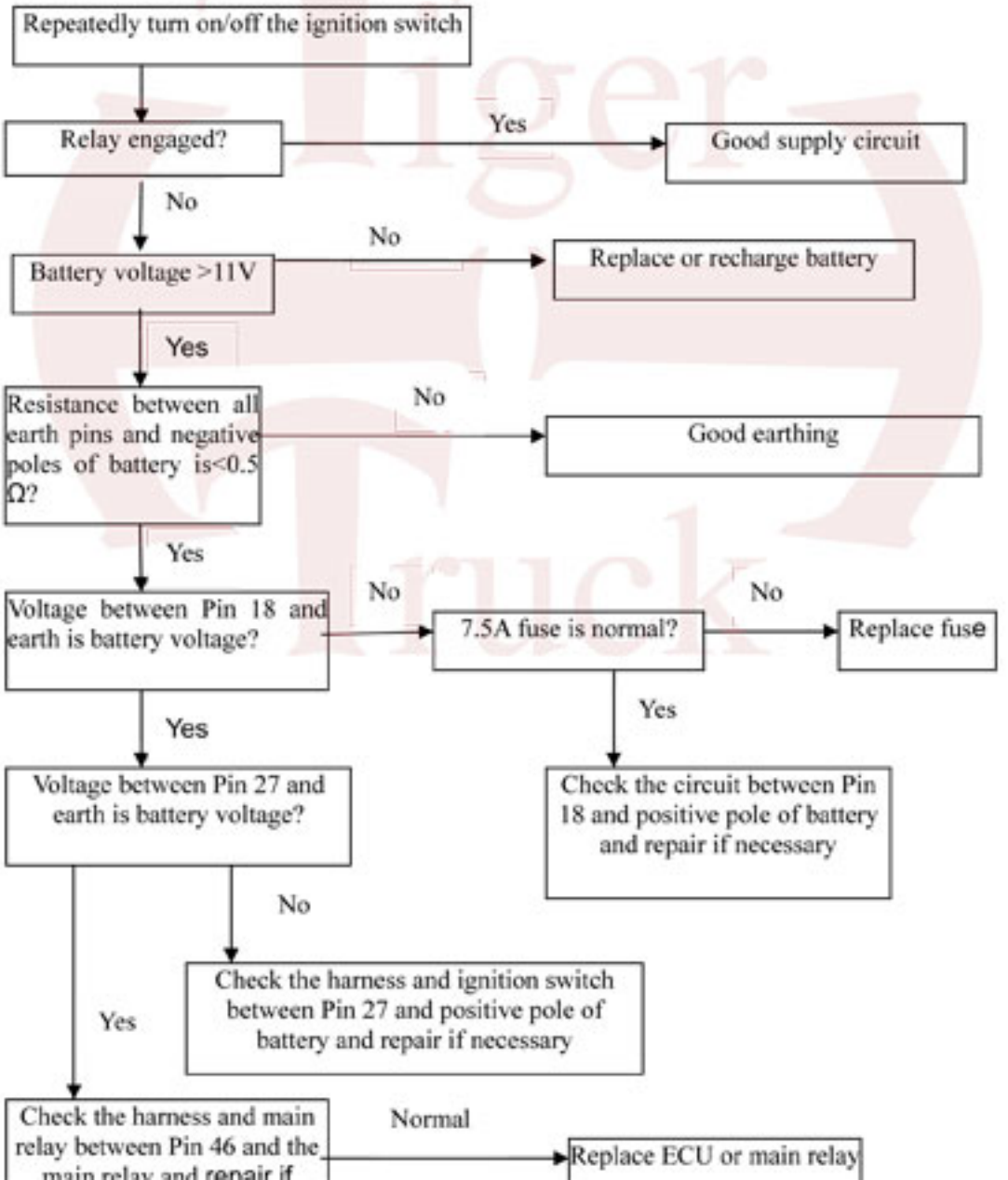
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1.9.2.4. Power supply of electronic control system and circuit of ignition switch

Circuit diagram



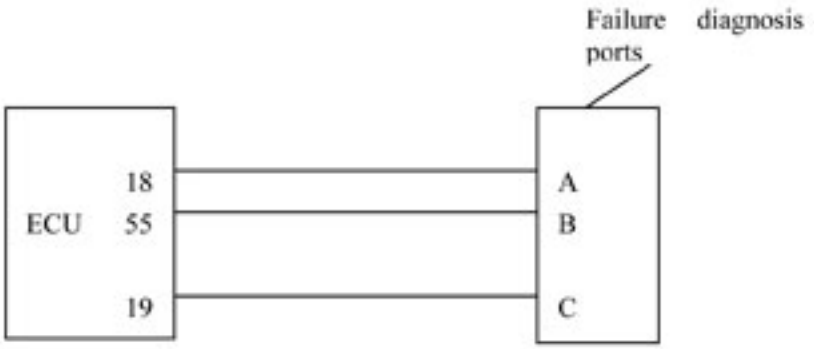
Failure diagnosis:



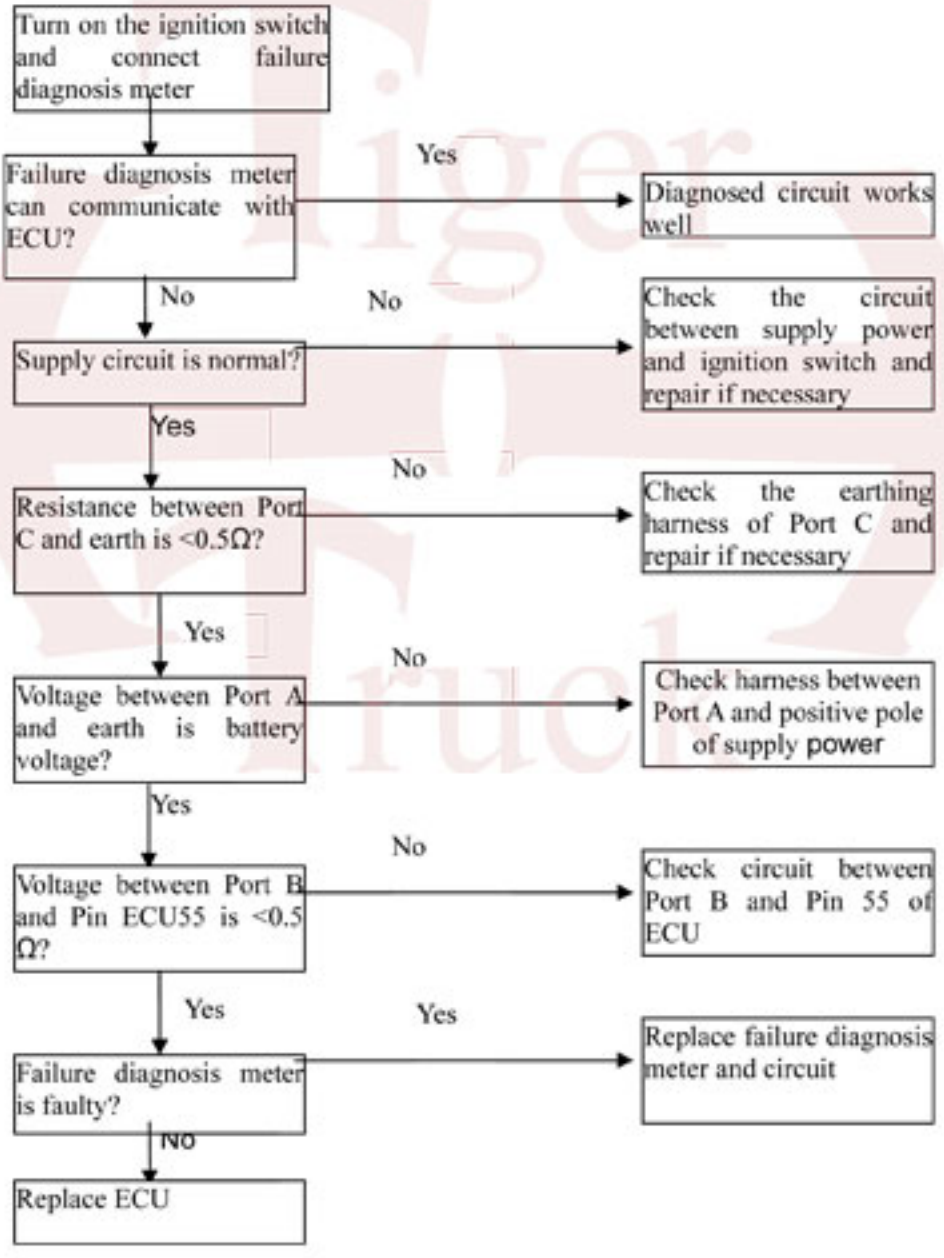
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1.9.2.5. Self-diagnostic circuit

Circuit diagram:



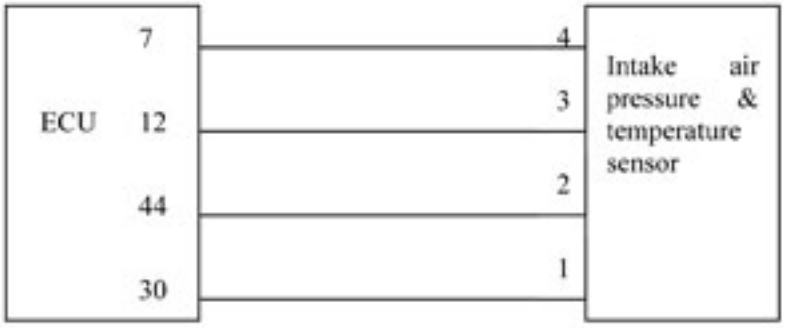
Failure diagnosis:



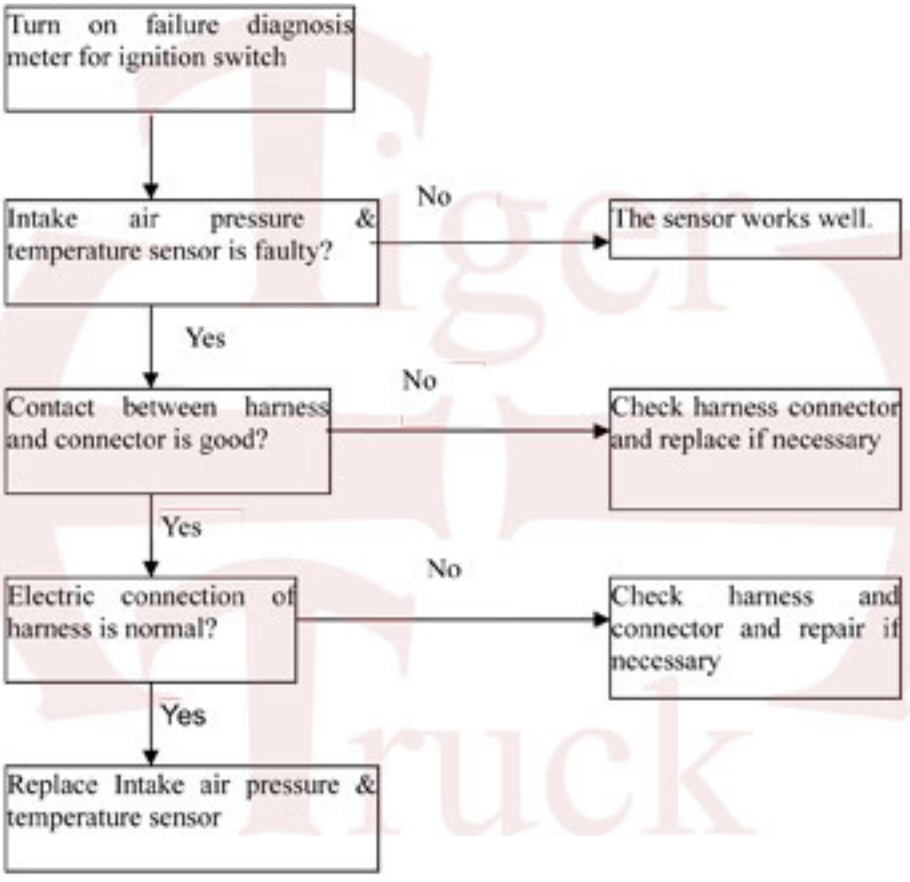
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1.9.2.6. Intake-air pressure and temperature sensor

Circuit diagram:

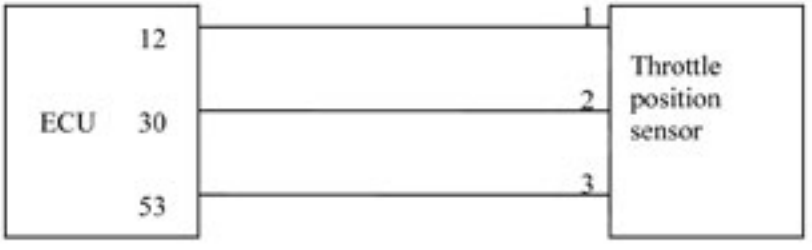


Failure diagnosis:



1.9.2.7. Throttle position sensor

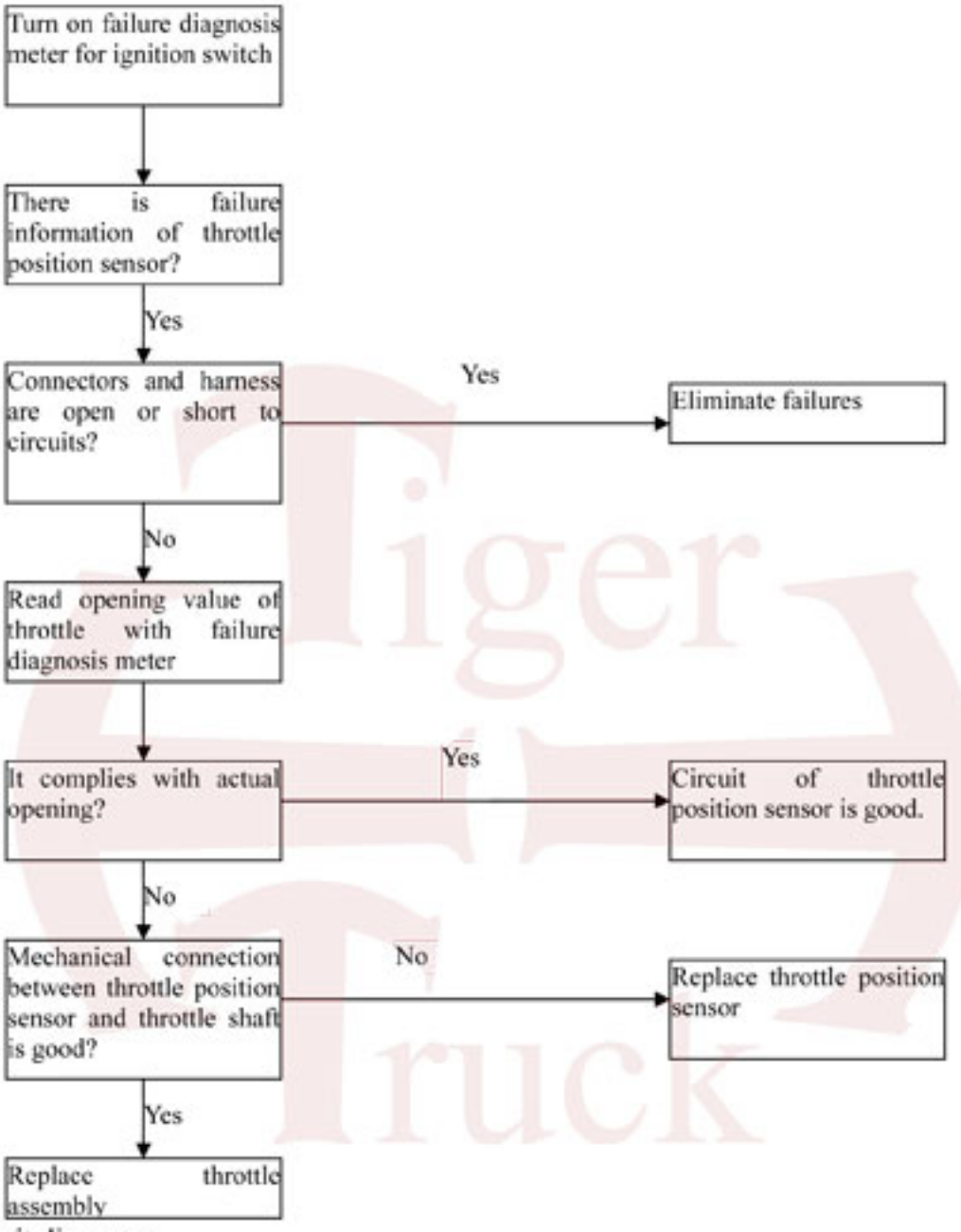
Circuit diagram:



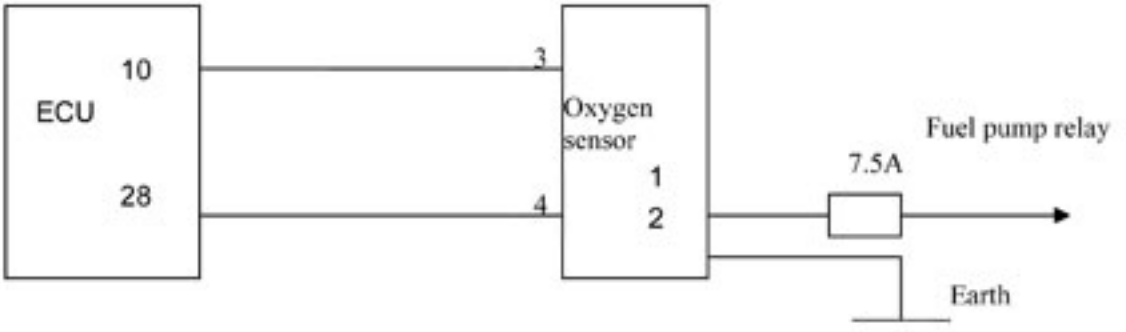
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Failure diagnosis:

1.9.2.8. Oxygen sensor

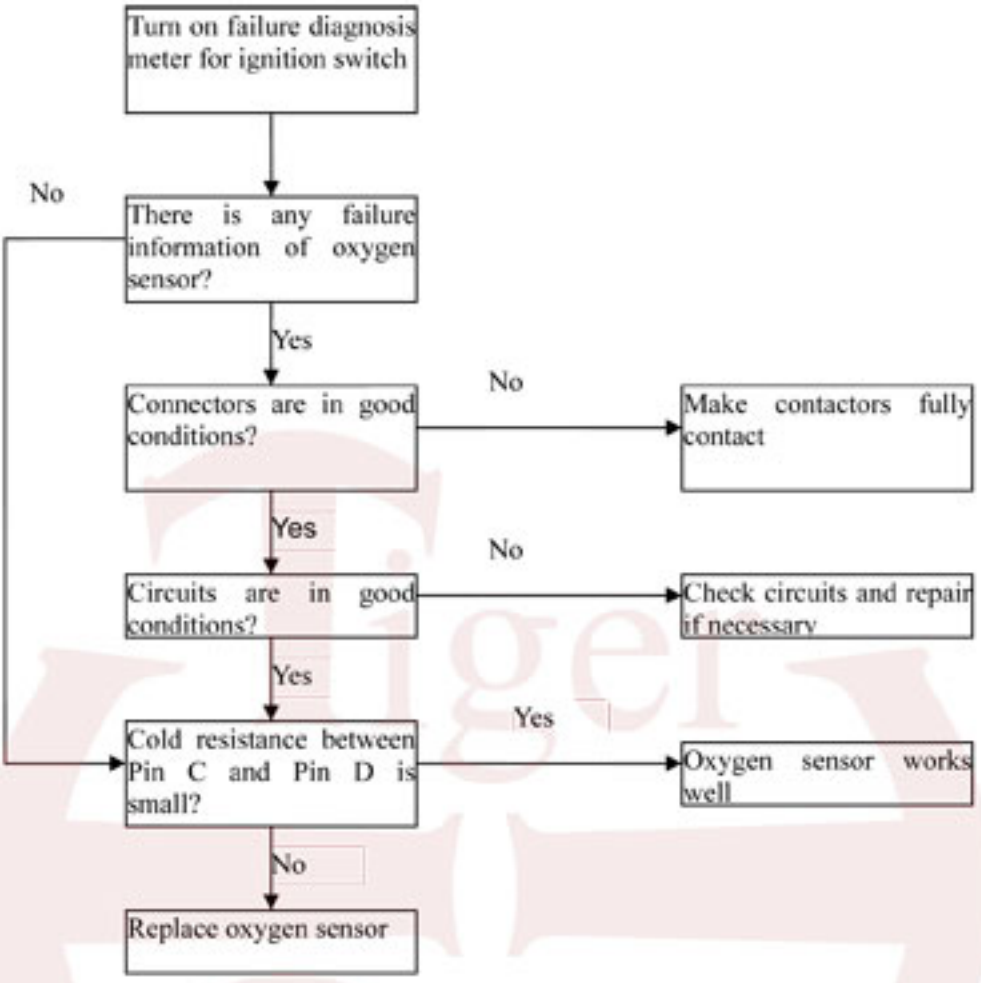


Circuit diagram:



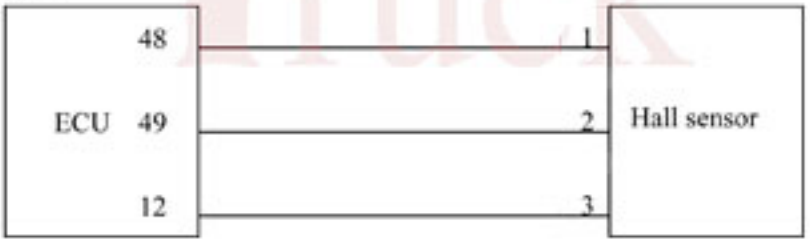
Failure diagnosis:

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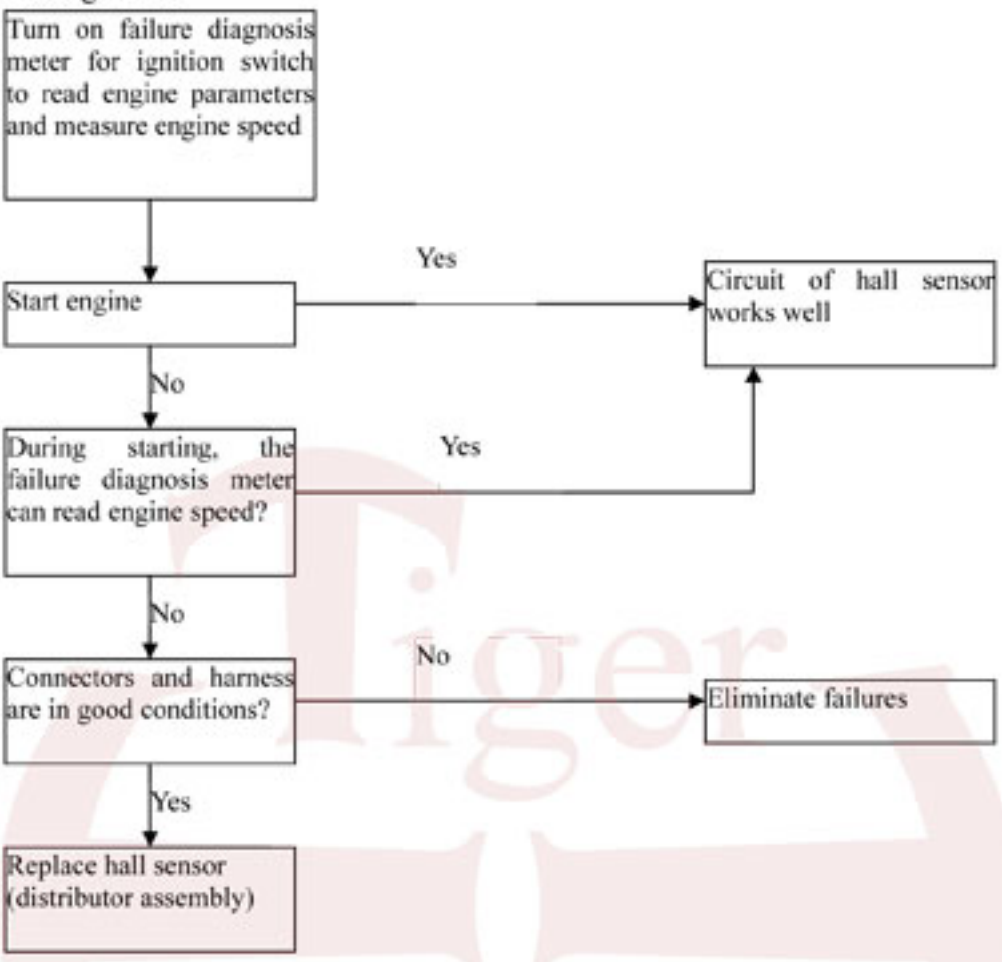
1.9.2.9. Resistance of hall sensor

Circuit diagram:



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Failure diagnosis:



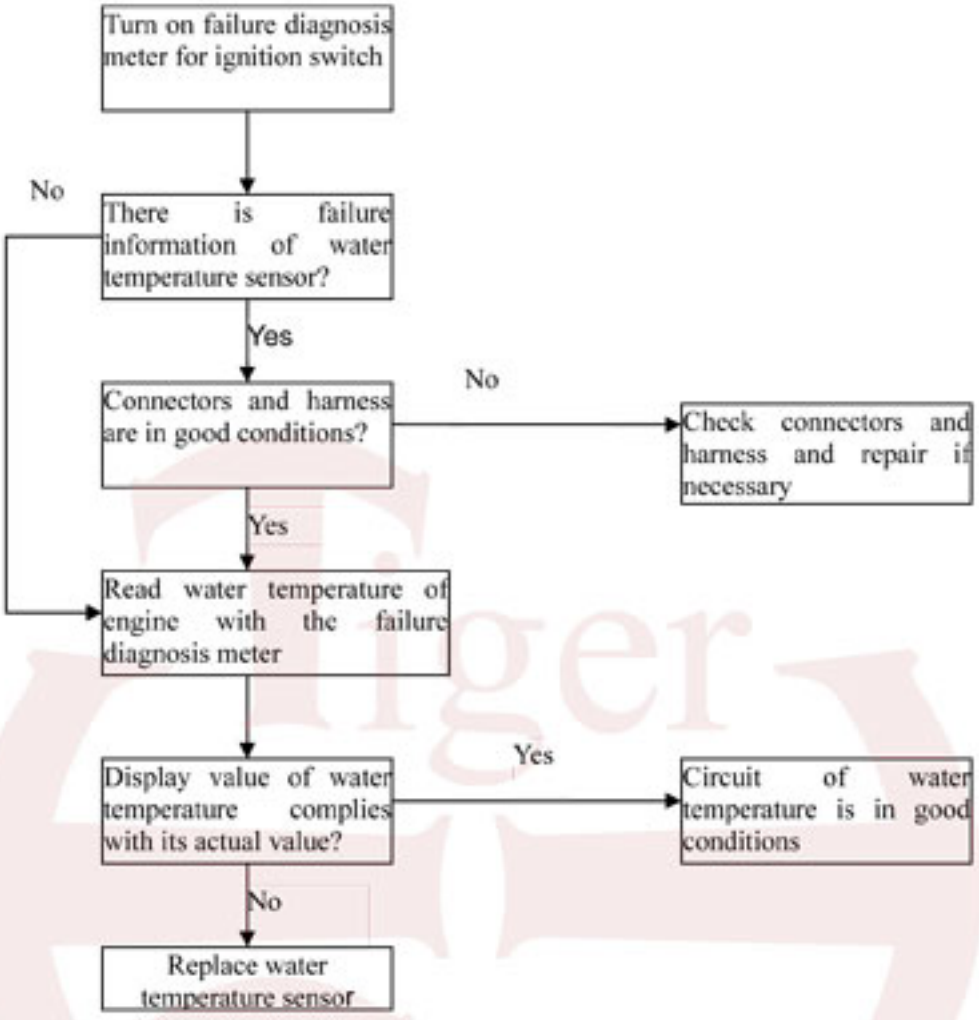
1.9.2.10. Water temperature sensor

Circuit diagram:



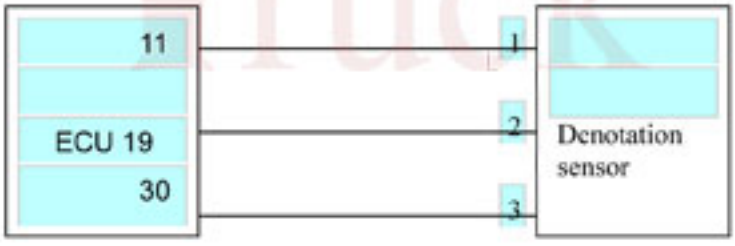
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Failure diagnosis:



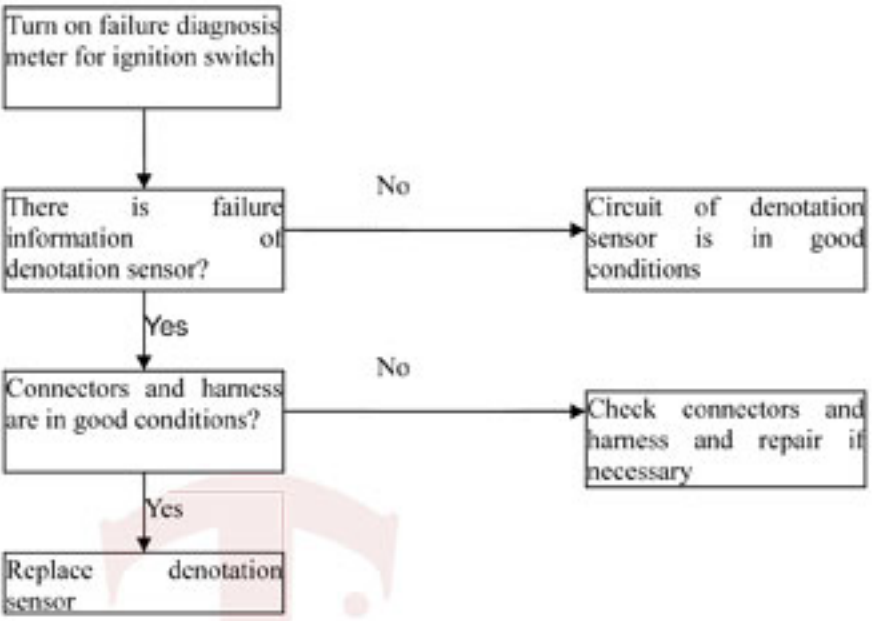
1.9.2.11. Circuit of denotation sensor

Circuit diagram:



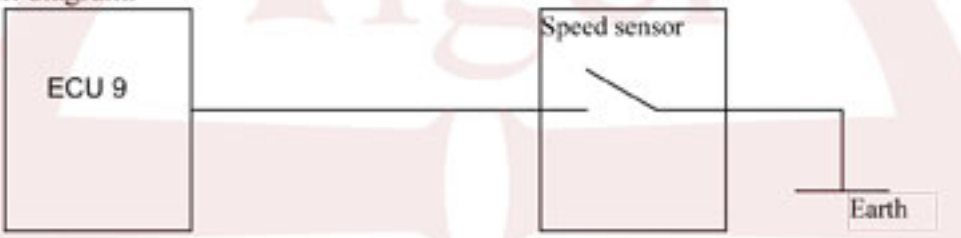
Failure diagnosis:

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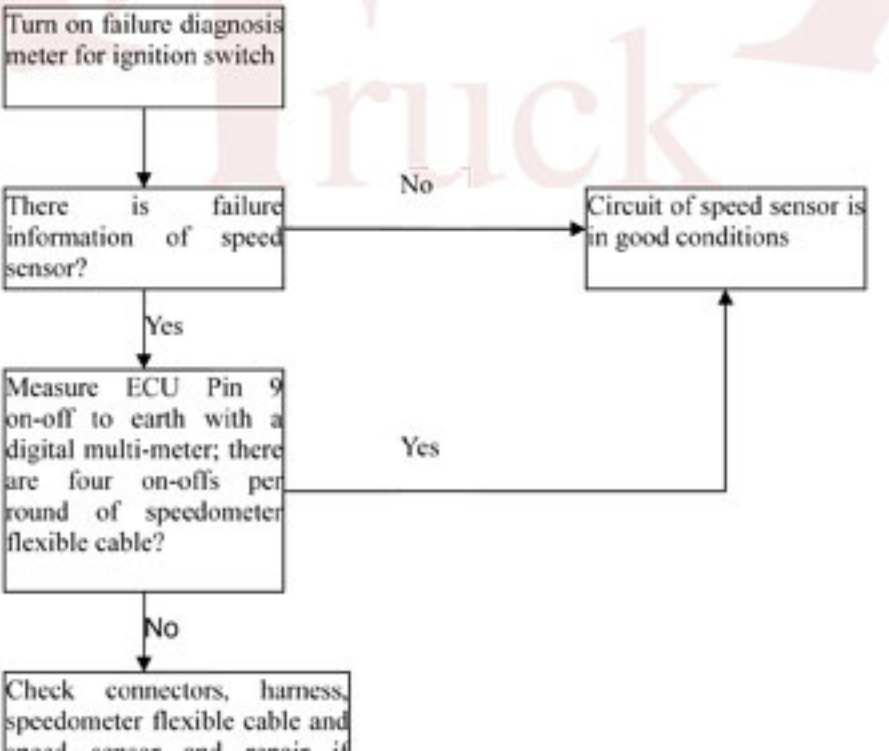


1.9.2.12. Circuit of speed sensor

Circuit diagram:



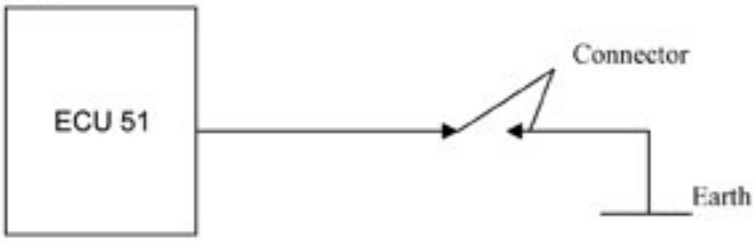
Failure diagnosis:



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1.9.2.13. Correcting circuit of ignition advanced angle

Circuit diagram:



Failure diagnosis:

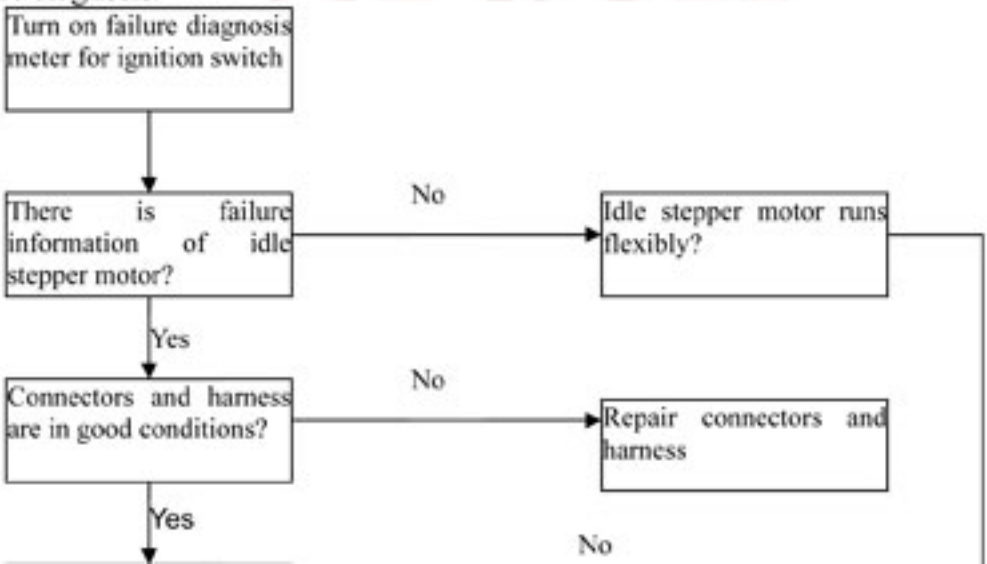
When the engine works well, the connector shall be disconnected, checking with ignition timing lamp whether ignition advanced angle changes a lot at different speeds of the engine, or checking whether harness of Pin 51 of ECU is earthed or leaks electricity to earth; if not, earthing voltage of ignition correction circuit shall exceed 4V.

1.9.2.14. Circuit of idle adjusting stepper motor

Circuit diagram:



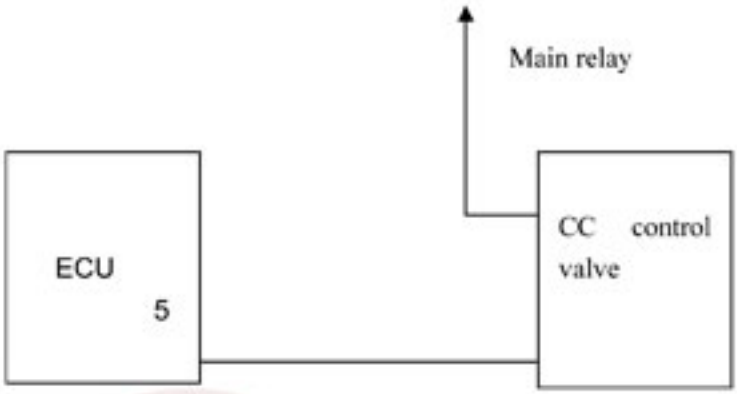
Failure diagnosis:



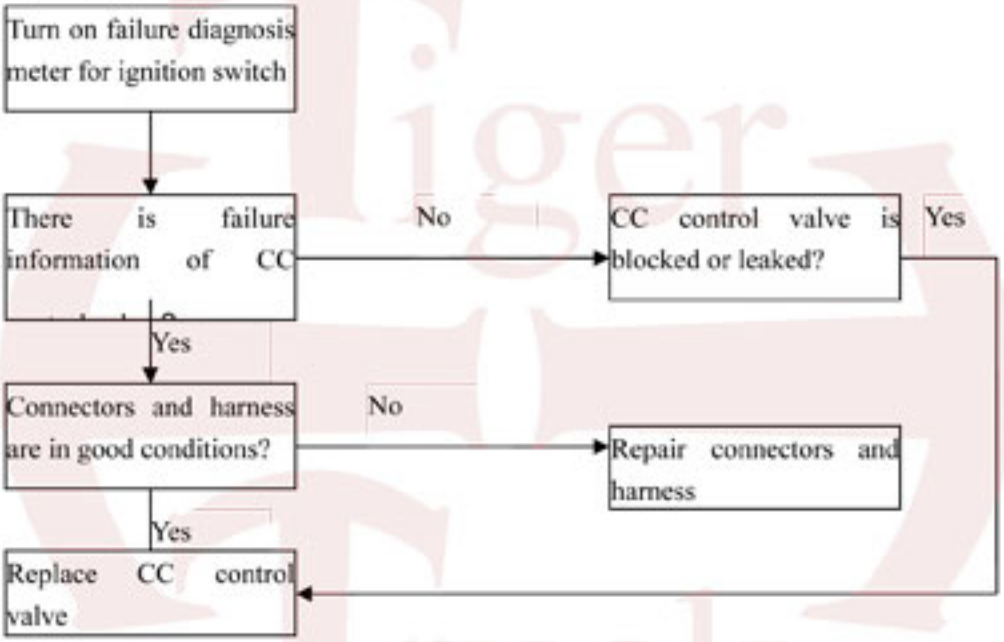
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1.9.2.15. CC control valve

Circuit diagram:

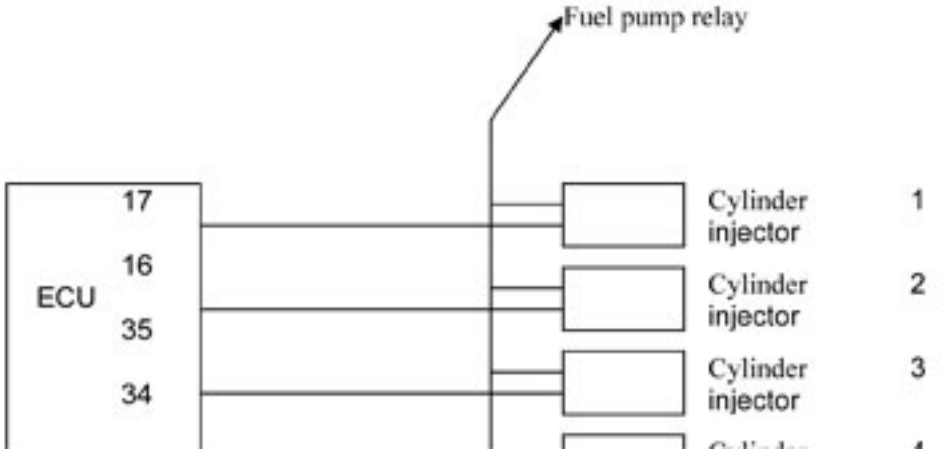


Failure diagnosis:



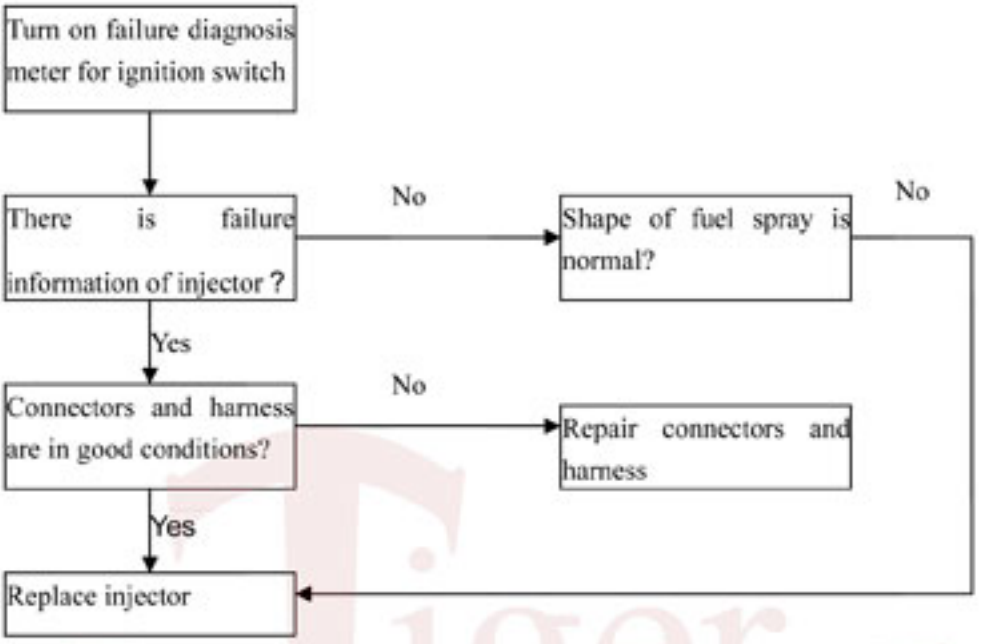
1.9.2.16. Circuit of injector

Circuit diagram:



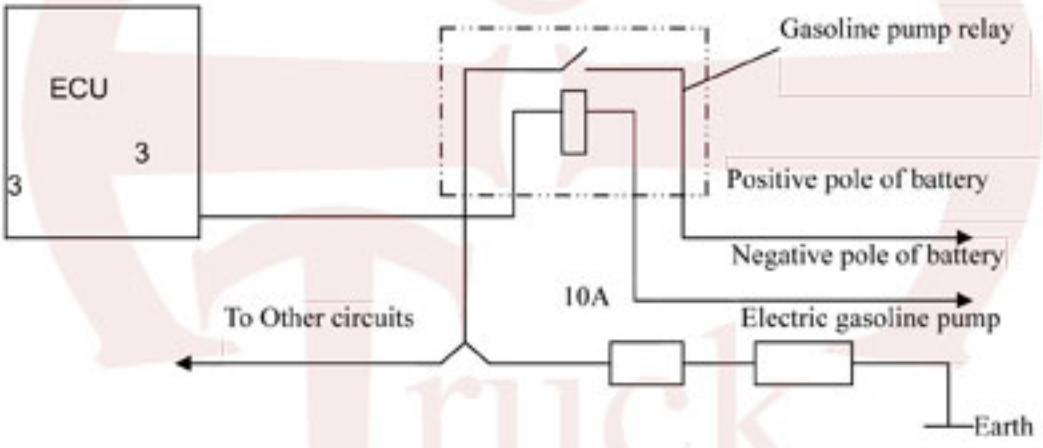
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Failure diagnosis:



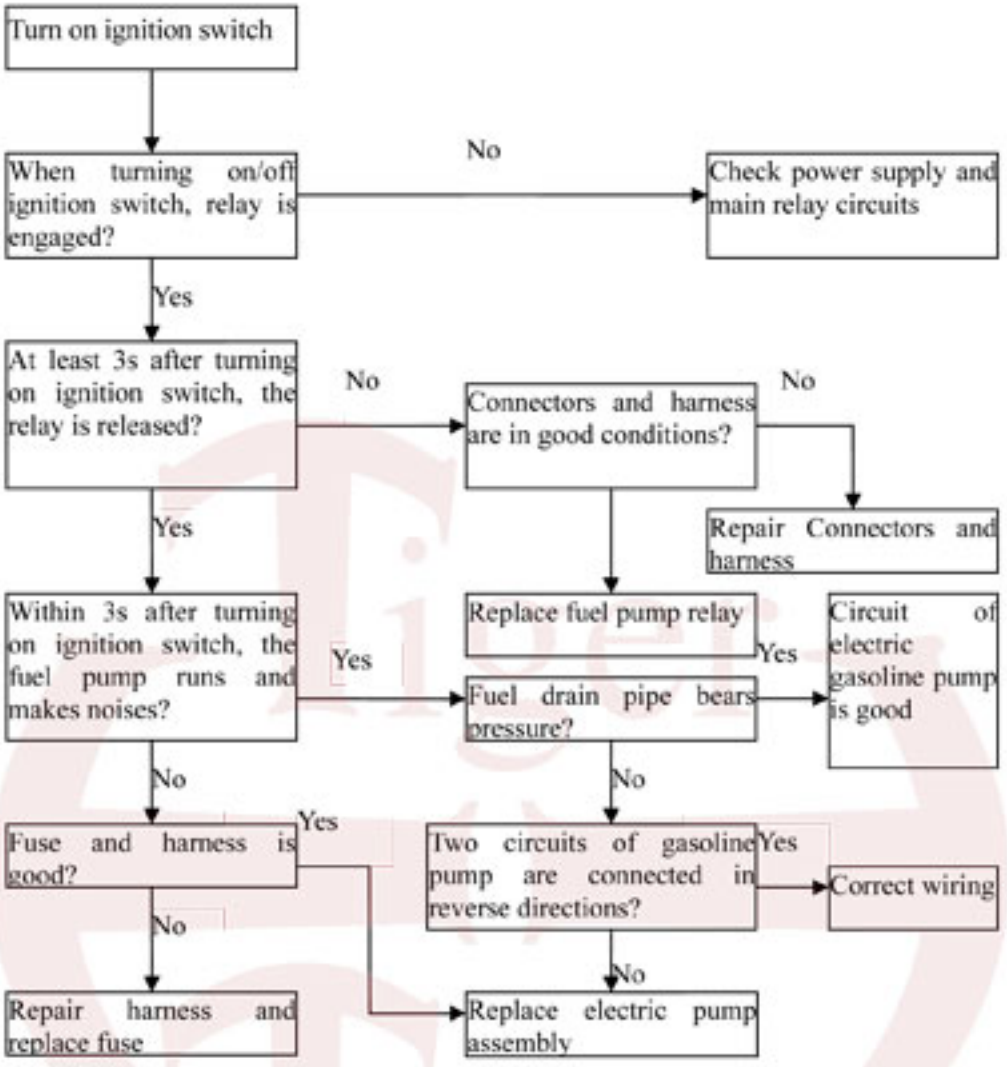
1.9.2.17. Circuit of electric gasoline pump

Circuit diagram:



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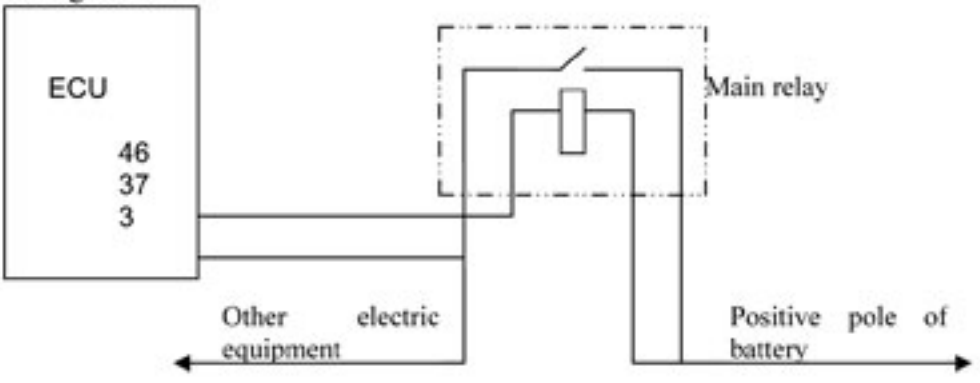
Failure diagnosis:



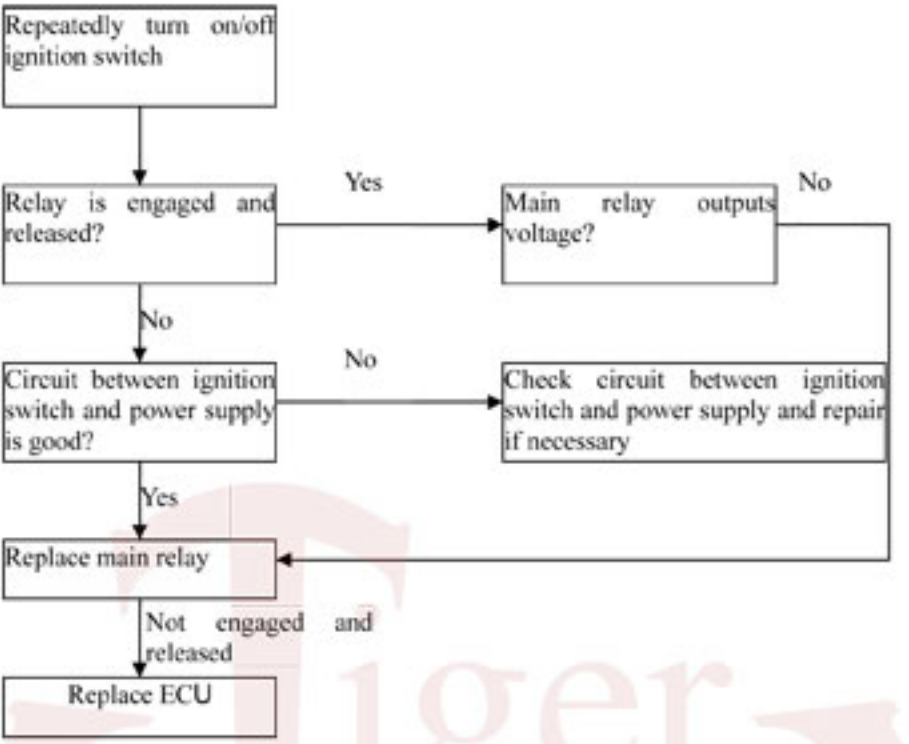
1.9.2.18. Circuit of main relay

Circuit diagram:

Failure diagnosis:

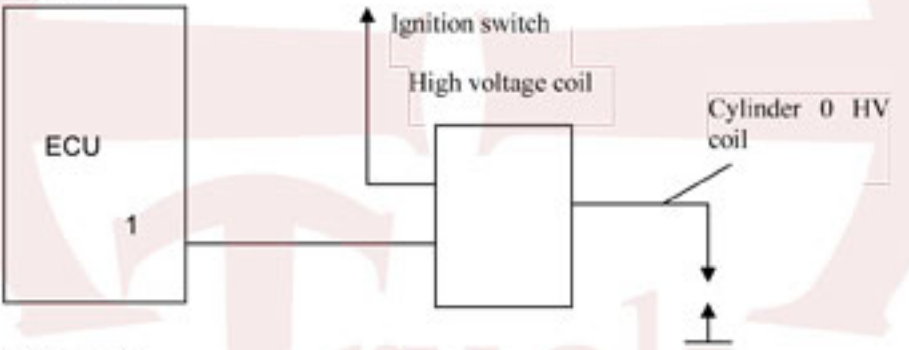


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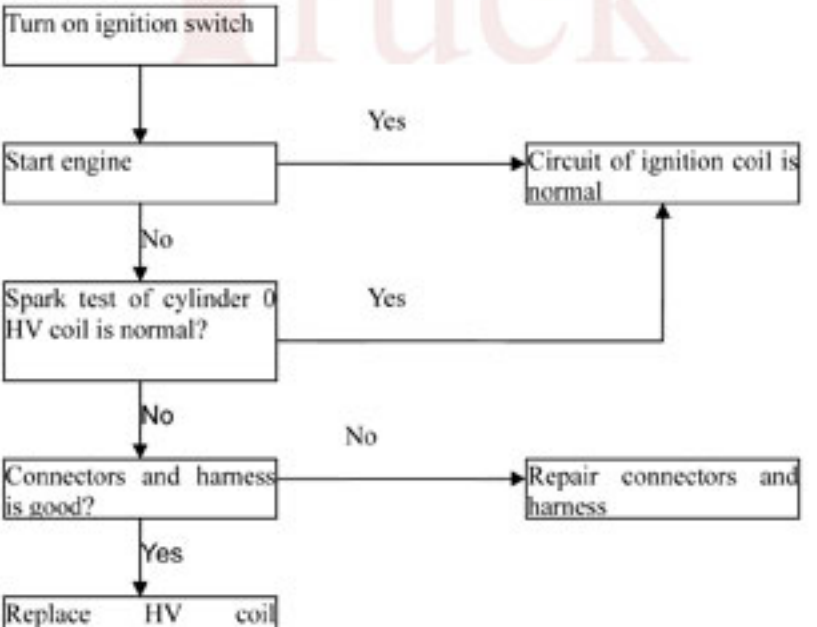


1.9.2.19. Ignition coil

Circuit diagram:



Failure diagnosis:



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1.9.3. Failure Maintenance

Note:

(1) Controller (ECU): At the first time of staring engine, when ECU plug and battery terminal are removed, the ignition key shall stay in the position of ignition at least for 10s, then staring. Otherwise, idle speed of the engine may be unstable.

(2) Due to high reliability of components in the electronic control system, it is a little of possibility that each component fails; the system is usually repaired and replaced after removing relevant mechanical failures.

(3) Most failures of electronic control system are caused by connectors and harness, so they shall be carefully check and repair if necessary.

1.9.3.1. Disassembling and Assembling of ECU

connector

(1). Disassembling:

1). Open a connector latch;



2). Turn a plug



3). Pull out the plug



(2). Inspection:

Check whether the connector is distorted or corroded.

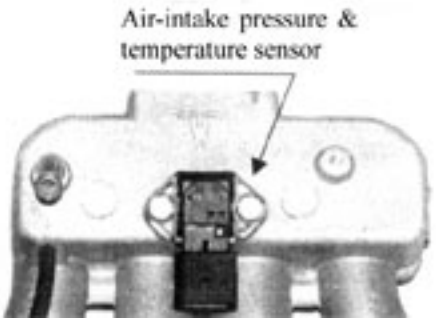
(3). Assembling:

Assemble the connector as per the reverse sequence of disassembling, and lock the latch well.

1.9.3.2. Intake-air pressure and temperature sensor

(1). Disassembling:

1). Remove an electronic connector;



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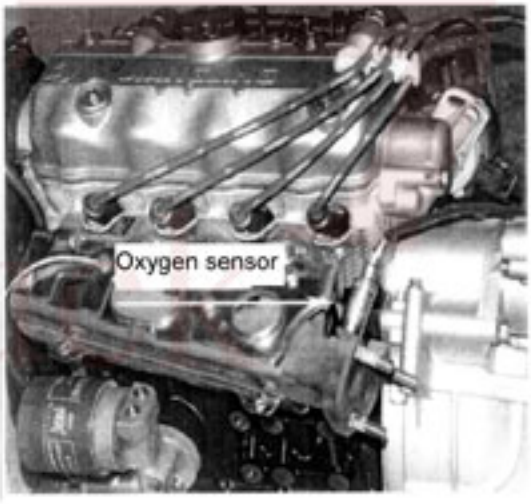
2). Remove a mounting bolt;
3). Take out the sensor.
(2). Inspection:
1). Whether an O-ring is in good conditions;
2). Whether a connector is distorted or corroded;
3). Clean oil.
(3). Assembling:
1). Paint a little of grease in the O-ring;
2). Assemble the sensor as per the reverse sequence of disassembling;
3). Bolt torque: 7±1Nm.

1.9.3.3. Engine water temperature sensor

(1). Disassembling:
1). Drain engine coolant;
2). Remove an electronic connector;
3) Remove the water temperature sensor.
(2). Inspection:
1). Whether there is a good appearance;
2). Whether the connector is corroded.
(3). Assembling:
1). Assemble the sensor as per the reverse sequence of disassembling;
2). Bolt torque: 20Nm.

1.9.3.4. Oxygen sensor

(1). Disassembling:
1). Remove an electronic connector;
2). Remove the oxygen sensor.
(2). Inspection:
1). Whether there is a good appearance;
2) Whether the senor hole is blocked;
3). Whether the sensor makes abnormal sound.



1.9. 3.4. Assembling

1). Paint a little of high temperature lubricant in the thread, but not allow it infiltrating into the sensor hole.
2). Assemble the sensor as per the reverse sequence of disassembling;
3). Assembling torque: 50Nm.

1.9.3.5. Detonation sensor

(1). Disassembling: remove the sensor from the cylinder body.
(2). Inspection:
1). Whether there is a good appearance;
2). Whether the connector is clean or corroded.

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(3). Assembling:

1). Assemble the sensor directly in the cylinder body without any washer;

2). Assembling torque: 20Nm.

3). Assemble as per specified torque.

1.9.3.6. Main relay and fuel pump relay

(1). Disassembling: pull out the relay from the relay socket.

(2). Inspection:

1). Whether the connector is corroded;

2). Whether there is oil;

3). Whether Pins 85 & 86 of the relay are open.

(3). Assembling:

1). Insert the relay in the original direction;

2). Both relays can be exchanged for use.

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1.10 Comprehensive Engine Trouble-Shooting & Maintenance Norms

1.10.1 Comprehensive engine trouble shooting

1.10.1.1 Diesel engine

Trouble	Cause	Method
Unable to start or cannot run smoothly after starting.	• Battery power insufficient • Starting circuit misconnected or terminals loosened. • Malfunction of starter • No fuel in fuel tank • Air in fuel system • Fuel line clogged • Fuel pump stopped or intermittently supplies fuel • Fuel filter clogged • Air cleaner cartridge seriously clogged. • Oil atomizer does not inject oil, or injects a small amount of oil, or atomizes improperly. • Fuel pump installed improperly. • Timing phase improper. • Fuel pump malfunctions. • Air valve leaks. • Piston ring or cylinder sleeve worn excessively. • Idle speed is too low. • Start under loan. • Auxiliary devices for starting malfunction in winter. t	Charge or replace Correctly make connection and fix connector lugs. Repair or replace Refueling to full Vent and check Check and repair Check, repair or replace Repair or replace Clean or replace Adjust or replace Adjust Check and adjust Repair or replace Check and repair by lapping Replace Adjust Separate diesel engine from transmission, or set transmission to neutral position. Repair air heater
Diesel engine runaway Note: when diesel engine runaway happens, immediately shut off fuel system, and plug up air intake to stop diesel engine.	• Speed governor malfunction • Speed governor spring crack • Speed adjusting rack or annulus stuck	Check and repair Replace Check and repair
Diesel engine self	• Fuel polluted	Clean fuel line and refuel

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stops running.	• Air in fuel system • Fuel line clogged • Fuel filter clogged • High pressure fuel line leakage • Fuel pump malfunction • Nozzle clogged or malfunctioned. • Piston jammed with cylinder liner, cylinder scoring. • Push rod, tappets or camshaft damaged. • Camshaft and bearing locked	Vent and repair leaky spots. Check and repair Clean or replace Replace Repair or replace Replace Check cause and remove; replace damaged parts such as pistons, piston rings and cylinder liners. Check and replace Fuel pressure insufficient or caused by interrupted oil supply; lap journal and replace if necessary.
Abnormal running sound of diesel engine	• Fuel supply time too early; rhythmic metal knocks inside cylinder; • Fuel supply time too late; deep and unclear knocks inside cylinder; • Air intake valve clearance too big, rhythmic bigger metal knocks are heard at cylinder head. • No oil between rocker adjusting screw and push rod spherical face; "cheep" by dry friction are heard at cylinder head. • Gear backlash too big due to wear, when abrupt lowering of speed occurs, metal knocks are heard at gear housing. • Drive belt has squeezing noise, tension insufficient, or abnormal high load. • Intake or exhaust leakage produces leakage sound. • Clearance between piston and cylinder liner too big and knocks are heard at outer wall of cylinder block during running, which become serious when revolution increased. • Clearance between piston pin and small end of connecting rod too big, and slight sharp noise is heard during running, which becomes clear during idle running. • Main bearing and connecting rod	Check and turn down fuel supply advance angle. Check and turn up fuel supply advance angle. Check and properly turn down valve clearance. Dismount cylinder head cover, and add oil. Check all cylinder rocker arms or replace them at the same time. Adjust backlash or replace Check the belt of tensioning device, and assure a proper tension. Check air intake and exhaust system, and stop any leakage. Check and replace piston, piston ring or cylinder liner as necessary. Check and replace small end bush of connecting rod or piston pin as necessary.

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	bearing worn out to make matching clearance too big, and knocks are heard at crankcase, which become smooth and powerful at low speed running. • Axial clearance of crankshaft or camshaft too big, and knocks are heard back and forth at idle speed. • Water pump bearing and generator bearing are damaged and continuous noise is heard.	Disassemble and check main bearing, connecting rod bearing, and replace if wear is too big. Replace camshaft or camshaft thrust plate, and assure the required clearance. Replace relevant bearings water pump, and generator.
Abnormal vibration of diesel engine	• Diesel engine not running smoothly. • Diesel engine bearing loose or damaged. • Fault of shock absorber • Fault of fan wheel hub • Generator bearing worn out or damaged. • Flywheel not aligned. • Moving parts loose or damaged.	See the proceeding descriptions. Replace Replace Replace Replace bearing or generator Calibrate Check and replace
Diesel engine power insufficient	• Vehicle overload • Oil level too high. • Air cleaner clogged. • Serious carbon fouling of exhaust pipe or (and) silencer. • Fuel quality inferior • Fuel line clogged • Fuel filter clogged • Fault of fuel pump • Installation angle of fuel injection pump incorrect. • Valve clearance incorrect. • Diesel oil too hot • Poor atomization of fuel injection pump or injection pressure too low. • Fuel supply not sufficient. • Cylinder compression pressure insufficient • Brake seizure	Reduce load or change to lower speed gear. Drain oil to proper level. Clean or replace Clean Replace with required fuel. Check and repair Repair or replace Check and repair Adjust Adjust Check cooling system and remove water scale. Adjust fuel injection pressure, check nozzle matching parts or replace. Check fuel injection pump plunger matching parts and delivery valve for wear, and replace if necessary. Check valve or valve seat for poor tightness, check piston rings, piston and cylinder liners for wear, lap valve sealing conical face or replace

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	• Fuel supply time not proper	cylinder liners, piston or piston rings if necessary. Adjust brake clearance Adjust fuel supply ignition time.
Oil polluted	• Coolant in oil • Too much deposits in oil Fuel in oil: • Diesel engine running too cold • Fuel injection pump seal not proper, and has leakage. • Fuel injection pump pressure too low, or occasionally stuck, fuel not atomized. • Fuel injector plunger worn	Watercourse and fuel line connected, check and clear fault. Check all oil filter cartridge, replace and change oil at the same time if necessary. Check whether idle running time of diesel engine is too long which causes water temperature too low. Replace Check and adjust fuel injection pump pressure or replace parts. Replace plunger parts or fuel injection pump.
Oil consumption too big	• Oil leakage serious • Too much oil in oil pan • Oil quality incorrect • Oil cooler leaky • Oil carry-over in vacuum pump • Air cleaner cartridge clogged, vacuum pump intake negative pressure too big and oil carry-over • Valve guide worn out • Cylinder liner, piston, piston ring and valve sealing conical face worn • Diesel engine running at low load for a long time.	Check, and replace damaged parts. Drain oil to required level. Use oil of required quality. Check and replace damaged parts. Replace Clean or replace air cleaner cartridge. Replace Check and replace seriously worn parts. Properly increase load and avoid long-time low-load running.
Oil pressure too low	• Too little oil in oil pan • Fuel in oil, diesel engine running roughly or power decreased. • Coolant in oil • Oil specification incorrect	Add oil to required level. Check whether nozzles get stuck, if normal, replace fuel oil pump and change oil. Check for leakage oil coolant, cylinder liner, cylinder gasket,

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	• Oil filter clogged • Oil cooler clogged • Oil collector clogged • Air leakage in oil pump suction line • Oil pump gear, gear and housing surface wear • Pressure limiting valve or pressure-adjusting spring fractured • Camshaft journal, main bearing and connecting rod bearing wear causing a too big clearance.	cylinder block water chamber and cylinder head, replace leaky parts and oil. Use oil of required specification. Clean or replace cartridge Clean or replace cartridge Clean Repair or replace Replace oil pump Replace spring Replace worn bearing or camshaft.
Coolant temperature too high	• Coolant insufficient • Too much dust on radiator fin • Radiator rubber pipe squeezed flat • Oil level incorrect • Fan guard damaged • Fan drive belt loose • Thermostat malfunction, water taking small cycle • Fuel injection pump supplying too much fuel • Vehicle overload • Cooling water line clogged • Water pump fault • Air in cooling system • Fault of Water temperature indicator • Cooling water leaky • Fault of electronic fan or fan relay • Radiator damaged which makes radiator unable to be timely replenished from expansion tank.	Add coolant Clean Check and replace if necessary. Add or drain some oil. Repair Adjust Replace thermostat Adjust Reduce load and use lower gear. Clean clogged part. Repair or replace Check water pump suction rubber pipe clamping part for leakage; check cylinder head gasket for air leakage, replace as necessary; vent air from thermostat exhaust switch. Repair or replace Check and remove leakage. Check, repair and replace if necessary. Replace radiator cap.
Coolant consumption too big	• Radiator leaky • Diesel engine leaky from appearance surface • Diesel engine too hot or make radiator coolant overflowing due to compressed gas leakage.	Check and repair Check and repair When check cause or leakage, replace related parts if necessary. Repair or replace

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	• Oil cooler leaky • Cylinder gasket leaky. • Cylinder head cracked or perforated • Cylinder block cooling water line leaky • Radiator cap is damaged; hence, radiator can not be timely replenished from expansion tank to cause coolant overflowing from expansion tank.	Replace Replace Replace Replace radiator cap.
Fuel consumption too big	• Fuel system leaky • Resistance of air intake system increased. • Fuel supply advance angle of fuel injection pump incorrect. • Fuel injection pump improperly adjusted. • Trouble in fuel injection pump • Severe inner wear of diesel engine.	Check and repair Check air filter cartridge, clean or replace. Adjust Adjust Repair or replace parts. Check cylinder liner, piston, piston rings for wear; check valve and valve seat for poor tightness; check moving parts for wear and repair.
Abnormal smoke emission of diesel engine	Black smoke emission • Diesel engine overloaded • Air in fuel system • Air cleaner clogged. • Valve clearance incorrect, valve tightness poor. • Installation angle of fuel injection pump incorrect. • Air intake line leaky • The joining place between high pressure oil pipe adaptor and fuel injection pump not tight. • Fuel supply of cylinders not even. • Poor atomization of fuel injection pump or injection pressure too low. • Piston ring seal failed Blue smoke emission • Too much oil added in oil pan • Valve stem seal pulled out or damaged • Openings of piston rings located at a same side. • Piston rings stuck or worn too much	 Properly decrease load. Vent and check Clean or replace Adjust Adjust Check intake line, and strengthen seal. Reinstallation Adjust fuel injection pump. Clean fuel injection parts, and replace if necessary; readjust fuel injection pump of too low injection pressure. Check and replace if necessary. Add oil to oil dipstick. Replace valve guide oil seal. Reinstall according to required 120 degree distribution. Replace Properly increase revolution

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	White smoke emission • When diesel engine starts, some cylinders not ignited. • Coolant penetration in cylinders • Poor atomization of fuel injection, oil leakage, fuel injection pressure too low. • Too much moisture in fuel • Installation angle of fuel injection pump incorrect.	and load. Check cylinder seal and repair. Check fuel injection matching parts, lap or replace; readjust fuel injection pressure according to requirement. Change to fuel of required brand. Adjust

1.10.1.2 Gasoline engine

Trouble	Cause	Method
Engine startup difficult or unable to start	• No fuel in fuel tank • Fuel pump or its electric circuit faulty. • Fuel pressure regulator faulty • Oil line or fuel nozzle clogged • Idle speed stepping motor faulty • Air intake pressure and temperature sensor and water temperature sensor faulty • Ignition timing or ignition order incorrect. • Distributor, ignition coil, cable or spark faulty. • Main relay or fuel pump relay faulty • ECU damaged • Air intake clogged. • Sparks not tightened or sealing gasket damaged • Valve clearance incorrect. • Valve seat not tight • Valve stem jammed • Valve spring weak or damaged • Cylinder head gasket leaky • Piston ring jammed or damaged • Piston, piston ring or cylinder damaged. • Timing belt fractured • Crankcase ventilation control valve faulty. • Adaptor loose or vacuum hose not connected.	Add fuel. Check and repair Repair or replace Clean Make maintenance and replace if necessary. Check, repair and replace if necessary. Adjust Repair or replace Repair or replace Replace Clean Tighten to required torque or replace sealing gasket. Adjust Disassemble cylinder head and lap valve. Repair or replace valve and valve guide. Replace valve spring. Repair or replace Replace piston rings Replace piston rings and piston. Re-bore cylinder or replace cylinder. Replace Replace Reliable connection
No idle	• Ignition timing or ignition order incorrect.	Adjust

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speed or poor idle speed of engine	• Distributor, ignition coil, cable or sparks faulty.	Repair or replace
	• Fuel or fuel pressure insufficient	Add fuel.
	• Idle speed stepping motor faulty	Check, repair or replace
	• Throttle position sensor and water temperature sensor faulty	Check, repair or replace
	• Throttle cable faulty	Check and repair
	• Pipes connected with intake manifold leaky.	Check, repair or replace
	• Canister control valve faulty	Check, repair or replace
	• Controller no self-learning action	Check and repair
	• Voltage abnormal	Tightening
	• Connections loose or vacuum hose drop-out	Replace
	• Crankcase ventilation control valve faulty.	(To be continued)
	• Engine overheated	
Engine power insufficient	• Throttle cable adjustor not properly adjusted.	Adjust
	• Fuel pressure insufficient	Check and remove trouble.
	• Nozzles faulty	Check, repair or replace
	• Air intake pressure and temperature sensor or water temperature sensor faulty	Check, repair or replace
	• Idle speed stepping motor faulty	Check, repair or replace
	• Ignition timing calibration circuit earthed	Adjust
	• Distributor, ignition coil, cable or sparks faulty.	Repair or replace
	• Ignition timing improperly adjusted	Re-adjust
	• Air intake/exhaust not smooth	Check and repair
	• Brake seizure	Repair or replace
	• Clutch slipping	Adjust or replace
	• Connection is loose or vacuum tube comes off.	Reliable connection
Engine reaction dull	• Throttle position sensor, intake pressure temperature sensor etc. faulty	Check, repair or replace
	• Distributor, ignition coil, cable or sparks faulty.	Check, repair or replace
	• Fuel system faulty	Check and repair
	• Idle speed stepping motor faulty	Repair or replace
	• Ignition timing improper	Adjust
	• Sparks not tightened or sealing gasket damaged	Tighten to required torque or replace sealing gasket.
	• Valve clearance incorrect.	Adjust
	• Valve seat not tight	Disassemble cylinder head and lap valve.
	• Valve stem jammed	Repair or replace valve and valve guide.

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	• Valve spring weak or damaged	Replace valve spring.
	• Cylinder head gasket leaky	Repair or replace
	• Piston ring jammed or damaged	Replace piston rings
	• Piston, piston ring or cylinder damaged.	Replace piston rings and piston Re-bore cylinder or replace cylinder.
Speed not stable	• Distributor, ignition coil, cable or sparks faulty.	Check, repair or replace
	• Throttle position sensor, intake pressure temperature sensor etc. faulty	Check, repair or replace
	• Fuel pressure not steady	Check and adjust
	• Nozzles faulty	Check, repair or replace
	• Idle speed stepping motor faulty	Repair or replace
	• Voltage too low	Check and repair
	• ECU faulty	Repair or replace
	• Vacuum hose leaky	Repair or replace
Fuel consumption too high	• Distributor, ignition coil, cable or sparks faulty.	Check, repair or replace
	• Ignition timing improperly adjusted	Re-adjust
	• Fuel pressure adjustor and nozzles faulty	Check and repair
	• Throttle position sensor, intake pressure temperature sensor etc. faulty	Check, repair or replace
	• ECU faulty	Repair or replace
	• Air intake/exhaust not smooth	Check and repair
	• Earth enrichment cable grounded	Adjust
	• Intake pressure temperature sensor clogged	Clean or replace
	• In front of or near exhaust system oxygen sensor leaky.	Repair
	• Sparks not tightened or sealing gasket damaged	Tighten to required torque or replace sealing gasket.
	• Valve clearance incorrect.	Adjust
	• Valve seat not tight	Disassemble cylinder head and lap valve.
	• Valve stem jammed	Repair or replace valve and valve guide.
	• Valve spring weak or damaged	Replace valve spring.
	• Cylinder head gasket leaky	Repair or replace
	• Piston ring jammed or damaged	Replace piston rings
	• Piston, piston ring or cylinder damaged.	Replace piston rings and piston. Re-bore cylinder or replace cylinder.
	• Valve seat improper	Repair or replace
	• Brake seizure	Repair or replace
	• Thermostat faulty	Replace
	• Tire pressure not normal	Adjust
Oil	• Oil drain plug loose	Tightening

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consumption too big	• Oil pan bolts loose	Tightening
	• Oil pan gasket deteriorated or damaged	Replace seal
	• Camshaft seal leaky	Replace
	• Cylinder head gasket leaky	Replace
	• Oil filter not tightened	Tightening
	• Oil pressure switch loose	Tightening
	• Cylinder head gasket broken or damaged	Replace
	• Camshaft seal leaky	Replace
	• Piston ring jammed	Remove carbon and repair piston rings.
	• Piston and cylinder worn	Replace or bore and replace piston.
	• Piston rings and grooves worn	Replace piston rings and piston.
	• Piston ring opening position incorrect	Adjust piston ring opening.
	• Valve stem seal wear damaged.	Replace
	• Valve stem worn	Replace
Fuel pressure insufficient	• Oil pressure switch faulty	Replace
	• Oil insufficient	Add oil sufficiently.
	• Oil filter net clogged	Clean
	• Oil pump performance poor	Replace
	• Oil pump safety valve worn	Replace
	• All moving parts clearance too big.	Replace worn parts
Overheat	• Coolant insufficient	Add coolant.
	• Water pump belt slack	Adjust
	• Thermostat malfunction	Replace
	• Water pump performance poor	Replace
	• Ignition timing misadjusted	Adjust
	• Radiator clogged or leaky	Clean, repair or replace.
	• Air in cooling system	Check water pump suction rubber pipe clamping part for leakage; check cylinder head gasket for air leakage, replace as necessary; vent air from thermostat cap exhaust switch.
	• Engine oil variety incorrect	Replace with correct variety of oil.
	• Oil filter or oil screen clogged	Replace or clean (oil filter net)
	• Oil insufficient	Again add sufficiently.
	• Oil pump performance poor	Repair or replace
	• Oil leakage	Repair
	• Brake seizure	Repair or replace
	• Clutch slipping	Adjust or replace
	• Cylinder gasket damaged (blow-by)	Replace

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1.10.2 Engine Maintenance Norms

1.10.2.1 Cleaning and protection of engine

Auto engine is composed of many precisely processed parts with extremely high precision of surfaces, which can be measured only by micrometer. Therefore, carefulness and cleanness are very important in maintenance of any inner parts of engine. Notes:

(1) During assembly, apply enough engine oil to friction surfaces to protect and lubricate inner working surfaces.

(2) When disassembling valves, pistons, piston rings, connecting rods, connecting rod bearings, and crankshaft main bearing, specifications should be followed.

(3) Reassemble them to the same positions and same matching surfaces as in disassembly.

(4) Before maintenance of engine, remove battery cables.

(5) If not, harness or other electronic elements may be damaged.

(6) The four cylinders of engine are numbered 1, 2.3 and 4 in the sequence from crankshaft belt pulley to flywheel.

1.10.2.2 General description of engine maintenance

(1) When lifting engine, jack should not be supported directly against oil pan. Due to slight clearance between oil pan and oil pump filter, improper operations may lead to deformation of oil pan to further damage oil sensor.

(2) Note: when engine is running, and maintenance is needed, 12v electric system may be seriously short-grounded and such damaged.

(3) If electric terminals may be grounded, remove battery earth cable.

(4) Whenever air cleaner, and intake manifold are disassembled, all inlets should be covered to prevent foreign matters from occasional entering.

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(5) When disassembling cable adaptor, it can be held only by hand, and harnesses are not allowed to be pulled. As for plugs with clips, be sure that they can be removed only after clips are pressed open.

(6) When connecting clip-type plugs, insert them until "rattles" are heard, which means that they are reliably connected.

1.10.2.3 Preventive measures for maintenance of fuel system

(1) Maintenance should be carried out at a well-ventilated place. When working, it is strictly forbidden to smoke, and be away from open fire.

(2) Fuel injection engine: Even if engine is closed, fuel supply line is still in high pressure state, any loosening and disconnection of fuel line may directly cause danger to maintenance personnel. Therefore, before fuel supply line is loosened or disconnected, be sure that pressure is reduced in accordance with "fuel depressurizing procedure".

(3) After fuel line is disconnected, a small amount of fuel may still flow out.

(4) To prevent any damage to personnel, connectors to be disconnected should be covered with cloth. After reassembly, the cloth should be kept in required container.

(5) When engine and exhaust system are still in high temperature, it is prohibited to start engine while disassembling fuel pump relay.

(6) Methods for connecting fuel or fuel steam hoses are different for different pipes. When reconnecting fuel or fuel steam hoses, be sure connection is correct and each hose is tightly clamped.

(7) After connection, hoses should not be twisted or knotted.

(8) When reassembling injector or fuel pressure regulator, apply main shaft oil or oil to O-rings.

1.10.2.4 Fuel depressurizing procedure

After engine is confirmed to be cooled down, release fuel pressure according to following procedures:

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(1) Set gear-shift mechanism to "neutral position", pull parking brake system to position and stop driving wheel.

(2) Remove the plug at fuel pump relay.

(3) Remove fuel filler cap to release steam in fuel tank, and replace it.

(4) Start engine until remaining fuel is consumed. To reduce fuel pressure in fuel supply pipe, restart engine 2 ~ 3 times, each time about 3 seconds. At this time, fuel connecting pipes are in safe conditions for maintenance.

(5) After maintenance is completed, insert plug into fuel pump relay.

Fuel leakage inspection procedure

(1) After fuel system maintenance is completed, check it according to the following procedure to make sure there are no leakages.

(2) (Gasoline engine) turn on ignition switch for 2 seconds (to set fuel pump working), and then turn it off.

(3) Repeat the above-mentioned procedure 3 ~ 4 times to exert pressure for fuel supply pipe (until pressure is felt by hand at fuel return flexible pipe).

(4) Under this conditions, check all parts of fuel system for any leakage.

(5) (For diesel engines) loosen bleed screw of fuel injector, and press fuel pump to discharge air until out-flowing fuel has no air. Tighten injector bleed screw, press fuel supply pump, and check fuel supply pump – fuel filter – fuel injector pipe and all fuel return pipes for any leakage.

(6) If no fuel flows out of bleed hole, it means the fuel pipe between fuel tank and fuel supply pump has air leakage, and it is necessary to check and repair fuel line.

(7) Under the condition that harnesses of engine have been well connected, start engine to check high pressure fuel pipe for any fuel leakage.

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Chapter 2 Clutch

2.1 Clutch Structure

The clutch for Chang An SC1021 series truck is a single-plate diaphragm-spring clutch, consisting of a drive part, a driven part, a hold-down mechanism and an operated clutch mechanism. The flywheel of engine and the pressure plate belong to driving part and the friction disk belongs to driven part. The hold-down mechanism includes hold-down springs and the pressure plate; the operated clutch mechanism includes release lever and swing arm for release bearing. Refer to figure 2-1.

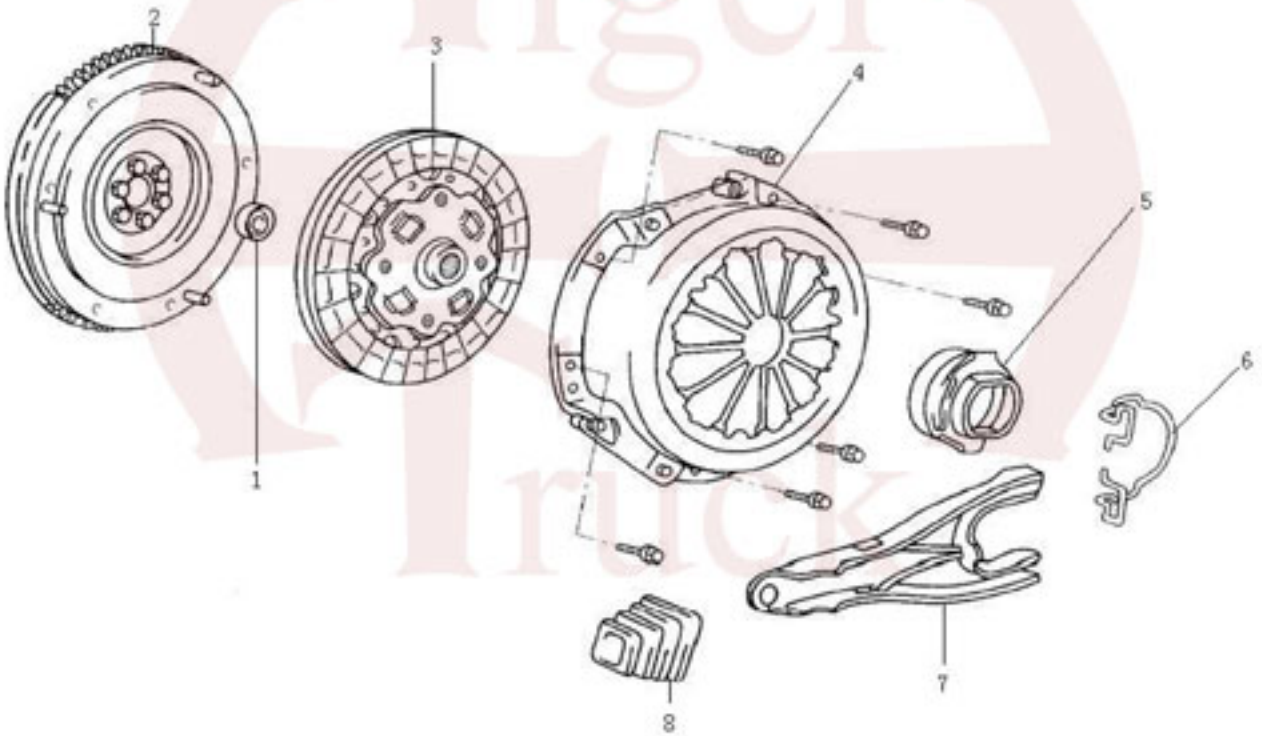


Figure 2-1 Diaphragm-spring clutch

1 – Guide bearing, 2 – Flywheel, 3 – Driven plate, 4 – Clutch cover, 5- Release bearing, 6 – Clip, 7 – Release fork, 8 – Protection Cover

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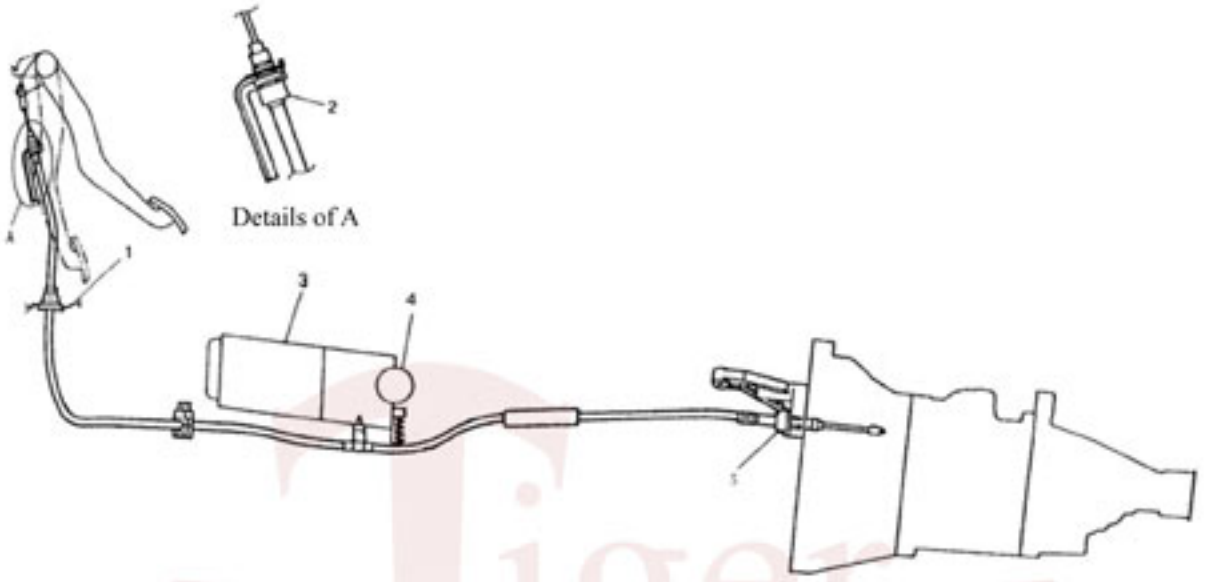


Figure 2-2 Layout of clutch cable

1 – Base plate, 2 – Sleeve, 3 – Installation bracket for hold-down lever, 4 – Cross member, 5 – Cable adjusting nut

2.2 Data for maintenance of clutch

Table 2-1

Model	Clutch for JL465	Clutch for JL474	Clutch for YD480
Gap of clutch yoke (mm)	2		4—6
Height of clutch pedal (mm)	122—155		
Free clutch pedal travel (mm)	2—7		

2.3 Maintenance of clutch

2.3.1 Disassembly of clutch

(1) Lift the vehicle with jack or lift, mount the installation bracket or lock the lifting mechanism;

(2) Remove male connectors of backup-lamp switch of clutch (figure 2-3);

(3) Disconnect the ground wire from the transmission;

(4) Loosen bolts of drive shaft from the drive axle (as for diesel truck, from the

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Figure 2-3 Male connector of backup lamp switch

1 – Connector of backup lamp switch, 2 – Transmission housing

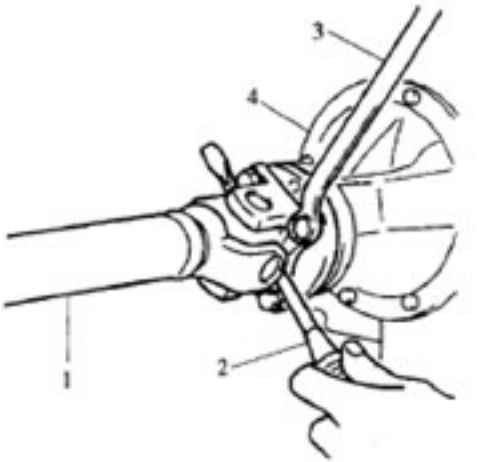
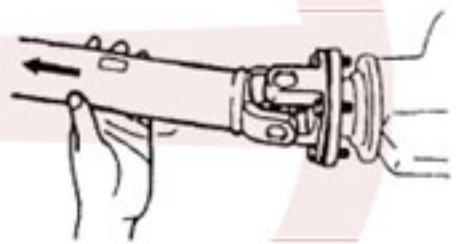


Figure 2-4 Remove drive shaft

1 – Drive shaft, 2 – Flat-tip screw driver, 3 - Spanner, 4 – Drive axle

(5) Remove the drive shaft and take off drive shaft assembly (figure 2-5);



(6) Remove the flexible speedometer shaft from transmission;

(7) Remove cable joints of gear selection and change lever of transmission and remove cable bracket of gear selection and change lever;

(8) Support the engine and the transmission by using the bracket and respectively remove bolts, hanging bolts and nuts connected to transmission and engine;

Figure 2 -5 Removing the drive shaft

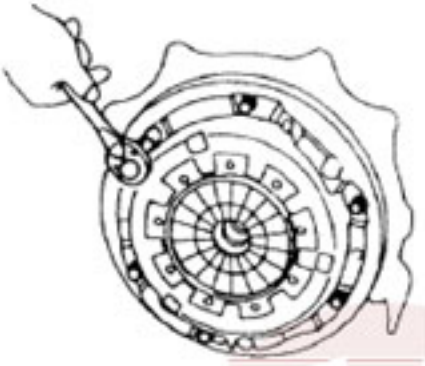
(9) Remove the transmission when the transmission does not connect to the body, the engine and other parts;

(10) Lock the flywheel with retaining driver of flywheel (figure 2-6);

(11) Remove tightening bolts from clutch cover with spanner and remove clutch assembly from flywheel (figure 2-7);

(12) Remove the bearing from the clutch shaft (figure 2-9);

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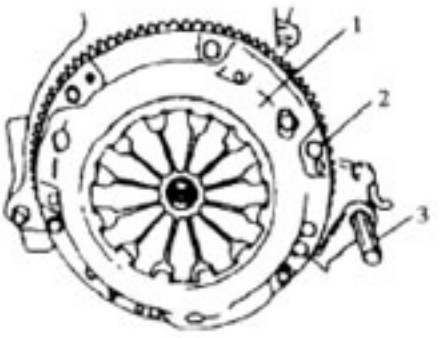


Figure 2-6 Installing the retaining driver of flywheel Figure 2-7 Removing clutch cover

1. Clutch cover, 2. Flywheel; 3. Retaining driver of flywheel





Figure 2-8 Removing the bearing of input shaft Figure 2-9 Removing the bearing

1- Special removal tool, 2- Flywheel

2.3.2 Service of main parts

(1) Driven disc

If the friction disc is slightly oil stained, clean it with gasoline oil then dry it with flame of blowtorch; if it is slightly hardened and burned, grind it with coated abrasive; If it is seriously worn and the depth of rivet head is less than the limit or it has cracks, and it is separated and seriously burnt or oil stained, replace the driven disc, as shown

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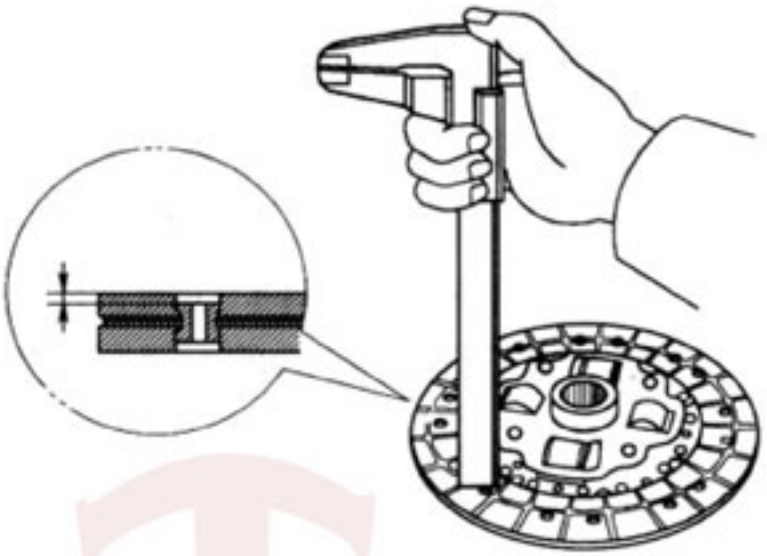


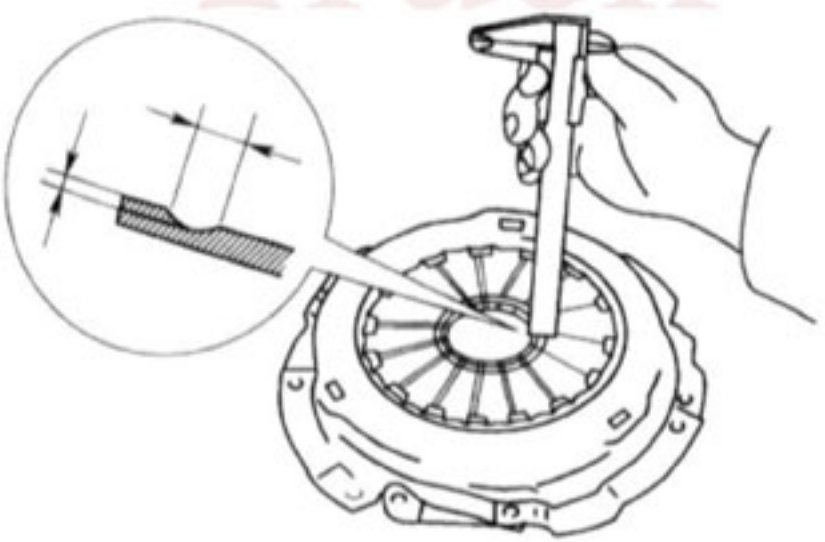
Figure 2-10 Rivet head depth measurement for driven disc

(2) Pressure plate, diaphragm spring

If the working surface of pressure plate is burnt, cracks and is slightly scuffed, grind it with oil stone. If the depth of groove is more than 0.5mm or the flatness error is more than 0.12mm – 0.20mm, grind and repair immediately. However, the total grinding amount should not be more than the limit (1mm – 1.5mm). After grinding, the pressure plate should be carried out the balance test again.

Check the diaphragm spring is worn. Check the depth and the width of diaphragm spring with vernier caliper and the amount of wear cannot exceed the limit. Refer to figure 2-1.

The pressure plate and the diaphragm spring cannot be removed and should be replaced assembly at the same time.



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(3) Release bearing

Turn the bearing with hands and check if it is flexible. If abnormality is found, replace it at once. This bearing is permanently lubricated so that it is no necessary to clean or lubricate. Refer to figure 2-12.

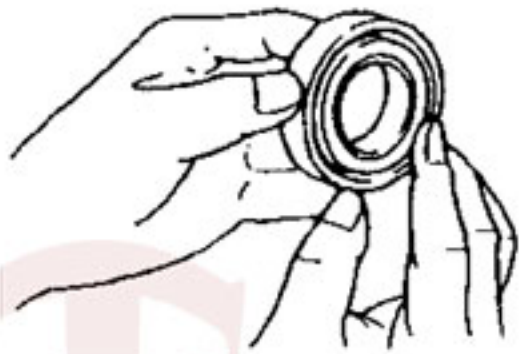


Figure 2-12 Inspection of release bearing

(4) Clutch cover

If the pressed-steel clutch cover has cracks, repair and weld it. Build-up weld can be used if any steps appear on drive window (hole) due to wear. If it is warped, correct it.

2.3.3 Assembling and adjustment of clutch

2.3.3.1 Assembling process and precautions for clutch

(1) Make sure friction disc is clean and apply grease to each joint.

(2) Check markings for assembling and mounting. Make sure the installation between clutch cover and pressure plate, balancing batch and clutch cover, clutch cover and flywheel should comply with original markings or positions so as to avoid balance destruction.

(3) Make sure the direction of driven disc during installation and the shorter side of disc spline hub faces to the flywheel.

(4) To ensure axiality of driven disc and crankshaft and easy installation of transmission, insert the disc by using anther transmission of this vehicle or special guiding axle during installation and localize by using guiding axle at the end of crankshaft.

(5) The heavy repaired clutch should be carried out the balance test along with crankshaft flywheel before loading.

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(1) Gap of yoke

Loose the adjusting nut for clutch cable, hold the inside of bracket for clutch with a straight steel ruler, poke the cable, observe the free travel of cable and make sure this free travel complies with requirements. Refer to figure 2-13.

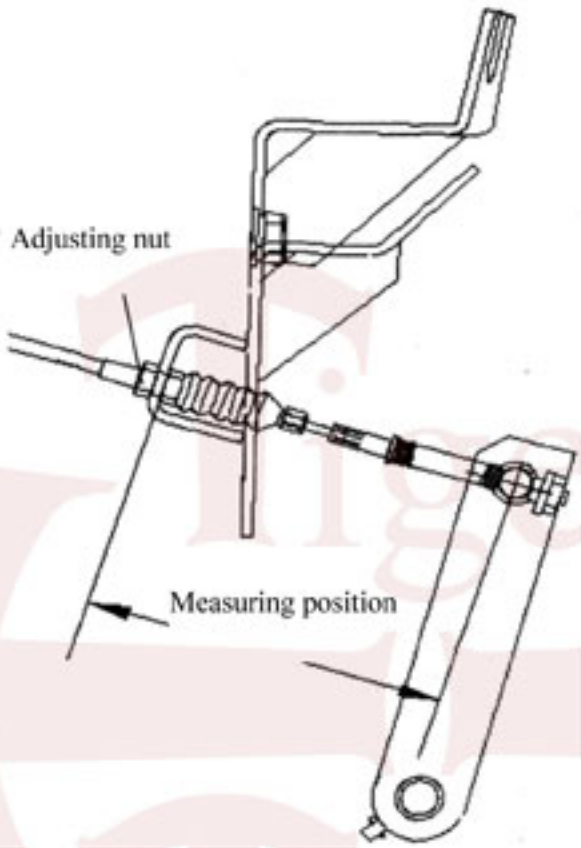


Figure 2-13 Gap adjusting for yoke (this figure shows 480 engine clutch adjustment)

(2) Free pedal travel

Slightly press the clutch pedal until the clutch generates resisting force. Refer to figure 2-14.

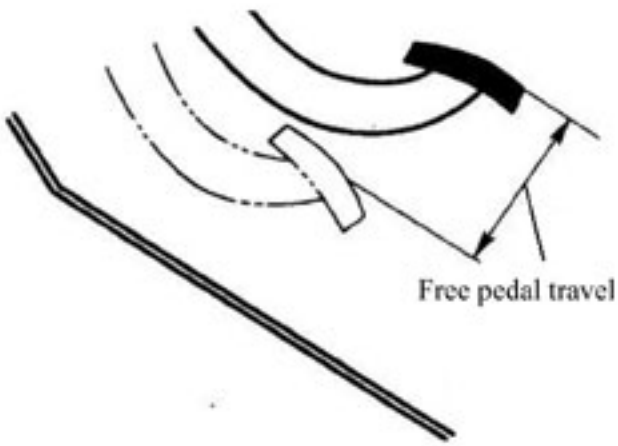


Figure 2-14 Free pedal travel inspection

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Inspect the height from ground to pedal. Loose the lock nut, rotate the stop bolt until the height meets the standard and tighten the lock nut. Refer to figure 2-15.

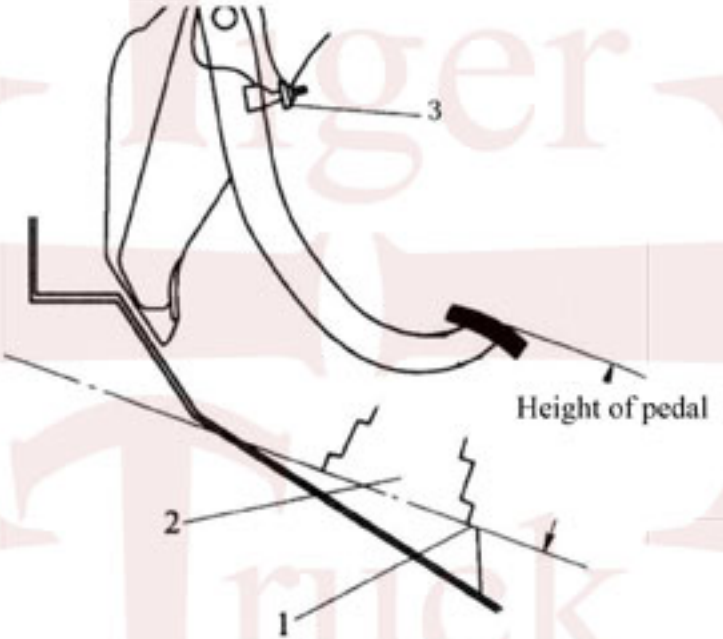


Figure 2-15 Height from ground to pedal

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2.4 Diagnosis of clutch

Common faults for the clutch include slipping, difficult disengaging, vibration, noisy, grabbing clutch, etc.

Condition	Possible cause	Correction
Slipping	• Small free clutch pedal travel. • Worn or oily clutch disc. • Warped pressure plate or flywheel surface. • Weakened diaphragm spring. • Rusted clutch cable.	Adjust free travel. Replace clutch disc. Replace pressure plate or flywheel. Replace clutch cover. Replace cable.
Difficult disengaging	• Large free clutch pedal travel. • Weakened diaphragm spring or worn spring tip. • Rusted input shaft splines. • Damaged or worn splines of transmission input shaft. • Excessively wobbly clutch disc. • Damaged or oily clutch disc.	Adjust free travel. Replace pressure plate assembly. Lubricate. Replace input shaft. Replace disc. Replace disc.
Clutch vibration	• Glazed disc. • Oily disc. • Release bearing slides unsmooth on input shaft bearing retainer. • Wobbly clutch disc or poor facing contact. • Weakened torsion springs in clutch disc. • Clutch disc rivets loose. • Warped pressure plate or flywheel. • Weakened engine mounting or loosened mounting bolt or nut. • Ragged pressure plated surface. • Ragged disengaging pawl of pressure plate.	Repair or replace disc. Replace disc. Lubricate or replace input shaft bearing retainer. Replace disc. Replace disc. Replace disc. Replace clutch cover or flywheel. Retighten or replace suspension cushion. Replace pressure plate. Replace pressure plate.
Noisy clutch	• Worn or broke release bearing. • Input shaft front bearing worn down. • Excessive rattle of clutch disc hub. • Cracked clutch disc. • Pressure plate and diaphragm spring are rattling. • Damaged friction disc.	Replace release bearing. Replace input shaft bearing. Replace disc. Replace disc. Replace disc. Replace disc.
Grabbing	• Clutch disc facings are soaked with oil. • Clutch disc facings are excessively worn..	Replace disc. Replace disc.

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Chapter 3 Transmission

3.1 Diagram of transmission

LG515, CAS520 and CAS525 five-stop transmissions are adopted for Chang'an light truck and they match with engines YND485Q, 485ZL, 490QB, 490QZL, 4100QB and 4100QB-2 respectively.

The diagram is shown in Fig. 3-1.The transmission is an ordinary gear-three shaft one which has five forward stops and one back stop. The transmission is realized by three synchronizers. Stops are shifted by full synchronizer.

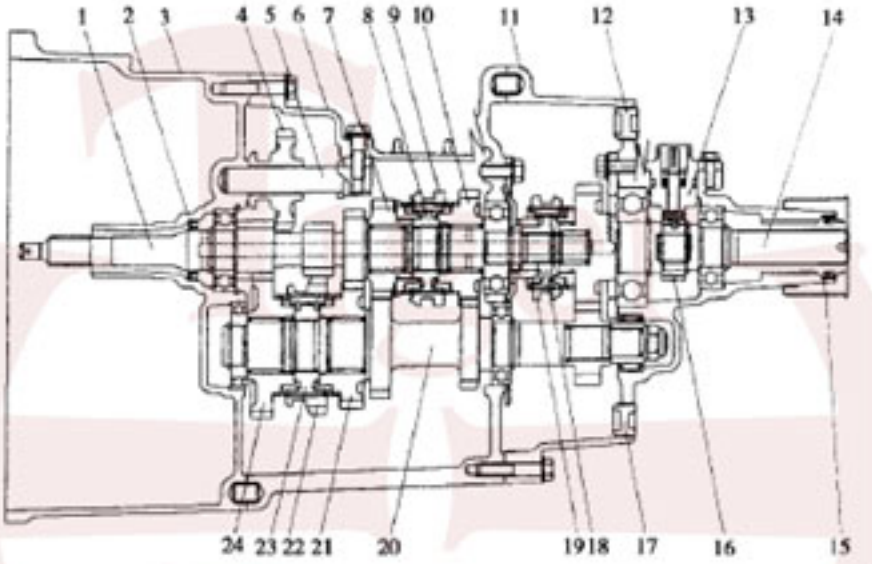


Fig. 3-1 Diagram of five-stop transmission

1-input shaft; 2-input shaft seal; 3-front casing; 4-back stop slip setting wheel; 5- back gear bearing; 6-rear casing; 7-input shaft third stop gear; 8-high speed synchronizer gear hub; 9-high speed synchronizer gear sleeve; 10-input shaft fourth gear; 11-extension tank; 12-oil filler; 13-speed meter driven gear; 14-main shaft; 15-extension tank rear seal; 16-speed meter driving gear; 17-oil drain; 18-fifth stop synchronizer gear hub; 19-fifth stop synchronizer gear sleeve; 20-medium shaft; 21-second stop gear of medium shaft; 22-low speed synchronizer gear sleeve; 23-low speed synchronizer gear hub; 24-first stop gear of medium shaft

3.2 Main parameters of transmission

Table 3-1

Transmission model		LG515	CAS520	CAS525
Center distance (mm)		70	85	85
Max. input torque (N.m)		150	200	250
Lubricating oil designation		80W/90		
Lubricating oil capacity (L)		1.1	1.7	1.7
bearing	Input, output	Ball bearing		
			Heavy conical roller	

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stop		Five stops for forward (synchronizer), one stop for backward		
Transmission ratio	I	4.008	6.478	6.478
	II	2.244	3.295	3.349
	III	1.336	1.902	1.902
	IV	1	1.345	1.345
	V	0.839	1	1
	R	3.522	5.830	5.830
Sealing glue	At thread	LOCTTTE 222,242,262		
	At plane	YH - 24R		
Axial clearance of medium shaft conical bearing (mm)		0 ~ 0.55		
Tightening torque of locking nut at ends of shafts (N.m)		180~200	180 ~ 200	200 ~ 250

3.3 Structure of transmission

3.3.1 Structural components, see drawing list.

3.3.2 Power transmission

Neutral

Synchronizer component jointing sleeve on main shaft is at neutral position and makes the stop gears on main shaft engage with the relevant gear and operate without loading so that no power can be transmitted to main shaft via synchronizer.

Power transmission of first stop

When gear lever is set at "low speed", selector fork of low speed gear pushes low speed synchronizer to low speed driving gear which engages with dog tooth, making low speed gear on main shaft engage with low speed driving gear of medium gear component. In that manner, the power from input shaft component is transmitted to medium gear shaft component after one stage of deceleration and then from medium gear shaft component to main shaft via another stage of deceleration.

Power transmission of second stop

When gear lever is set at "Second stop", the same low speed gear selector fork pushes low speed synchronizer to another direction making the second stop gear of medium shaft engage with main shaft gear. At that time, similar with the first stop power transmission, after two stages of deceleration, the power produced by engine is transmitted

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second stop gear.

Power transmission of third stop

When gear lever is set at "Third Stop", high speed shift fork stirs mesh collar of synchronizer to make the third stop gear on intermediate shaft and the third stop gear assembly on main shaft engage and synchronize, so the power from input shaft is sent to main shaft via intermediate shaft and synchronizer realizing power transmission of the third stop.

Power transmission of fourth stop

When gear lever is set at Fourth Stop, high speed shift fork make high speed synchronizer connect with gear of input shaft assembly via dog gear thus directly coupling input shaft assembly and main shaft assembly. At this case, there is no deceleration happened and engine crane shaft drives main shaft directly via input shaft.

Power transmission of fifth stop

The fifth stop is also called overgear. When gear lever is set at Fifth Stop, shift forks of back and fifth stop gears push synchronizer sleeve to make the sleeve engage with fifth stop gear of main shaft and transfer the power of intermediate shaft to main shaft thus driving the vehicle.

Back power transmission

When gear lever is set at Back, shift forks of back and fifth stop gears push synchronizer sleeve to make the sleeve engage with back gear of main shaft and transfer the power delivered to intermediate shaft by input shaft to main shaft via back shaft.

3.4 Wear analysis of main components

The main wear of transmission parts includes wear of matching pairs, casing deformation and cracks. These wears will reduce the working reliability of transmission and bring failures such as automatic disengagement, disturbed engagement, difficult shift, noise, leakage, etc.

Automatic disengagement is the most common failure of transmission. The essence is that there is an axial force produced on tooth face during transmission of engaged sliding gear or synchronizer sleeve, which is more than the lock force (the sum of the friction force of tooth face and the self locking force of shift fork) and pushes the gear from engagement to the neutral position automatically. Thus the formation of axial force is the root reason of automatic disengagement. Theoretically, there should not be any axial force produced by transmission of spur gear or synchronizer sleeve, but the worn parts or deformed casing may disturb the theoretical engagement condition and produce axial component force. Furthermore, the reduction of lock force is the conditional factor of automatic disengagement. Insufficient tooth length, disabled lock mechanism, etc will weaken the locking conditions.

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clearance of the matching positions of gear lever. Lever trembling is the projection of radically or axially vibration and swing of change gear on gear lever. Noise is resulted from the impact during gear transmission. For transmission with synchronizer, difficult shift is resulted from the disabled function of synchronizer components or locking components.

The main wear principles and their effects on assembly working reliability are analyzed as follows:

3.4.1 Transmission casing

The main wear of transmission casing includes cracks, deformation and wear of bearing hole. They are mainly resulted from working load and self gravity.

The working load is the force acted on the casing via shaft and bearing by gear during torque transmission. For common car transmission with the first and second shafts at its top, intermediate shaft at its bottom, front engine and rear drive, the effect principle of working load on transmission casing wear is:

It can be seem from the transmission process that the radical component forces of transmission between the first shaft and intermediate shaft and between intermediate shaft and the second shaft act on the front and rear ends of the casing via shaft and bearing. Their differences in size and direction will result in eccentric wear of bearing hole and deformation of casing thus making the space between the upper and the lower axes increase and that the space between the front ends is more than between the rear ends. This will produce parallelism error in the common plane of the two axes. In the same way, the difference of size and direction of peripheral component forces during gear transmission will make the casing twisted resulting in parallelism error (oblique) in different planes in the direction that is perpendicular to the common plane of the upper and the lower axes and the flatness error of the upper plane (warpage).During emergency braking (including central parking brake), the casing may also be twisted but its twisting direction is reverse to that produced by working load. When the vehicle runs often at low speed stop under heavy working condition, the casing will bear great twisting moment and so the shape and position error resulted from the above deformation will be observed more easily.

The above parallelism error of axis produced on transmission casing will make the transmission of cylindrical gear (or jacketed gear) familiar with that of bevel gear and helical gear and produce component force leading to automatic disengagement of transmission. At the same time, the non-parallelism of axial lines will make the meshing area of gears smaller, the unit pressure increased and the elastic deformation larger resulting in edge engagement. This will increase the speed variation and the unevenness of torque during transmission of gear. It is one of the reasons that produce engagement impact noise and aggravate gear wear.

The flatness error of the jointing plane between transmission casing and cover may result in oil leakage.

Under the action of gravity and impact, the front end face of the transmission which is fixed at the rear end face of engine body or flywheel casing will produce fretting corrosion and deformation, even rupture at the fixing bolt

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will make the front end face of the casing non-perpendicular to the axes of the first and the second shafts. The result is the same as the occasion that the rear end face of the flywheel casing is non-perpendicular to the axis of the crankshaft-the direct stop of transmission is easy to disengage, the bearing of the first shaft is easy to damage, oil leakage is easy to happen at the oil return helical line of the first shaft as well the driven disk of the clutch is easy to damage.

3.4.2 Shaft, bearing and gear

The wear and looseness between neck journal and bearing and between neck journal and gear not only produce noise but also will increase their matching clearance leading to the increase of central distance of engaged gears and the destruction of normal engagement. For stationary shaft, if the back shaft or stationary intermediate shaft fit tightly or transitionally with the casing, when their clearances are worn excessively, oil leakage will occur. If the clearances between shaft and gear and between shaft and flange matching spline are worn excessively, both transmission noise and oil leakage from output shaft spline will occur.

Normally engaging gears are easy to damage but slipping shift gears are prone to wear. Frequently, because of impact during stop shift, the gears will be worn and their teeth will be shortened. At the same time, the axial component force resulted from wear of hand lever, excessive gear axial clearance, incomplete engagement, etc becomes the common reason of automatic disengagement.

3.4.3 Synchronizer

The common deteriorations are wear of friction conical spiral groove, wear of lock chamfer of lock ring or lock pin. If the spiral tip is worn excessively, the oil film will not be broken making synchronous time lengthened and stop shift difficult. The wear of lock chamfer will make the locking effect unreliable and engagement before synchronization will occur and produce engaging noise.

3.4.4 Control parts

The wear of control parts mainly occur at matching position. It is the main reason of incorrect engagement that the wear at the matching positions of the spherical joint and shift fork. Wear of self-lock device and wear between shift fork and groove are one of reasons resulting in automatic disengagement.

3.5 Repair of main parts

3.5.1 Transmission casing and cover

The average cracks can be repaired by welding, but if there are cracks that pass through bearing hole or ones at installing and fixing position, the parts should be discarded.

When the shape and position error between transmission casing and planes exceeds the specifications in Table 3-2, these planes should be repaired. The methods may be filing, scraping or grinding.

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Table 3-2

Error description	Specifications (mm)
Flatness error jointing surface between casing and cover	
The length of jointing surface is not more than 250mm.	No more than 0.15
More than 250mm	No more than 0.20
Parallelism error between jointing surface of casing and cover and the common axis of the first and the second shafts	No more than 0.20
Flatness error of the front end face of casing	
The max. measurable diameter of end face: more than 50-120mm	No more than 0.08
More than120-250mm	No more than 0.10
More than 250-500mm	No more than 0.12
More than 500mm	No more than 0.15
End face circular run-out of casing front end to the common axis of the first and the second shafts	
The max. measurable diameter of end face: more than 50-120mm	No more than 0.08
More than120-250mm	No more than 0.10
More than 250-500mm	No more than 0.12
More than 500mm	No more than 0.15
Flatness error of the rear end face of casing	No more than 0.15
End face circular run-out of casing rear end to the common axis of the first and the second shafts	No more than 0.15

If the shape and position errors relevant to all the bearing holes exceed the specifications listed in Table 3-3 because the casing deformation or bearing hole wear, they should be repaired, or, seriously, discarded. Sleeve insertion method may be adopted during repair, not only the shape error of hole and its matching error with bearing but also the position error of all axes must be guaranteed. During maintenance, if the shape and position errors of transmission casing are excessive resulting in excessive nose or automatic disengagement, they should be generally discarded.

Specifications for shape and position error between transmission casing and shaft

Table 3-3

Error description	Specifications (mm)
Parallelism error between axes	Not 0.02 more than the original design
Dimension error between bearing holes	Not 0.02 more than the original design
Roundness error of bearing holes	No more than 0.008
Fit error between bearing hole and rolling bearing	
Basic dimension: more than 5—80mm	Not 0.02 more than the original design
More than 80-120mm	Not 0.025 more than the original design
More than 120-180mm	Not 0.04 more than the original design

If the fit error between casing and fixing shaft is 0.015mm more than the original design error, it can be repaired by brush plating or spay coating neck journal or brush plating shaft hole.

If the wear of bearing hole on the cover matching with the spherical joint at the middle of gear lever makes its

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The matching clearance between shift fork shaft and the cover (or the casing) should be 0.04-0.20. If the maximum value is exceeded, brush plate or replace the shaft or cover (casing) with new one as appropriate.

3.5.2 Gear and spline

There should not be any obvious defect or irregular wear on the meshing face of gear. For slight defect, grind it with oil stone; for serious defect, replace it with new one. Check as shown in Fig. 3-2.

For wear of tooth end of jointing gear or slipping gears matching with each other, the overhaul limit should not exceed 15% of the tooth width, the use limit is 30% of the tooth width; the overhaul limit of meshing side clearance of normally engaging gear should be 0.15-0.50mm and the use limit should not be more than 0.80mm; the overhaul limit of meshing side clearance of jointing gear should be 0.10-0.40mm and the use limit should not be more than 0.60mm; the engaging imprint of gears should be at the middle of the engaging face and should not be less than 60% of the engaging face. Except sleeved gears which may be repaired by build-up welding, if the above requirements can't be met, all parts should be replaced with new ones. In addition, both parts in one pair must be replaced to guarantee the engaging imprint.

The side clearance between slipping gear and shaft spline should not be 0.15mm more than the original design. The side clearances between gear seat, flange and other non-slipping parts and shaft spline should accord with the original design. If the specification is exceeded, the shaft spline may be repaired by build-up welding, but the side with less wear should be welded.

Check the slipping splines of shafts determine whether there are phenomena such as serious wear, distorted tooth, broken tooth, etc. If any, replace the shaft. Check of slipping spline (Fig. 3-3)



Fig. 3-2 Check of gear



Fig. 3-3 Check of slipping spline

3.5.3 Shaft

For the first, the second and the intermediate shafts, when taking the common axis of neck journals at two ends as datum, the radical run-out at the meddle should not be more than 0.03mm and 0.06mm (for shafts with length of more than 120-250mm and more than 250-500mm respectively).If the error exceeds the specification, correct it by

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Check bearings of input shaft, output shaft and intermediate shaft to determine whether they rotate smoothly, whether there is looseness between internal and external rings, and whether there are any abnormal phenomena, such as sounding, looseness and jamming.

fit between rolling bearing or gear and neck journal: for interference fit, there should no clearance after overhaul and the maximum interference fit value should not exceed the original design; for transitional fit, the clearance is allowed to 0.003mm more than the original design; for clearance fit, the clearance is allowed to 0.002mm more than the original design. If the specification is exceeded, the neck journal may be repaired by brush plating.

Fit between bushing and neck journal and bearing hole: for clearance fit or transitional fit, the clearance is allowed to 0.02mm more than the original design;

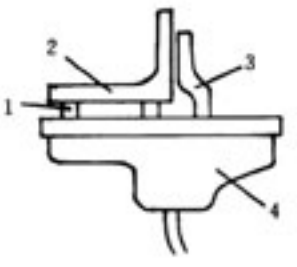
For interference fit, the original design should be met. If the specification is exceeded, replace the bushing with new one.



Fig. 3-4 Check of various transmission shaft and support shaft

3.5.4 Control parts

The end wear of shift fork should not be more than 0.4mm. The fit clearance between this end and gear ring groove should be 0.2-1.0mm.If the specification is exceeded, the worn end of shift fork may be repaired by build-up welding. The perpendicularity error of shift fork end to the axis of fork shaft hole should not be more than 0.2mm.If the error exceeds the specification, correct it by pressure. The inspection of perpendicularity error is as shown in Fig. 3-5. It can be carried out at transmission cover using square ruler.



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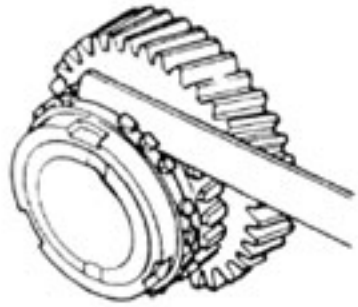


Fig. 3-6 Inspection of joint clearance between synchronizer gear ring and hub

The wear of ball end of gear lever and shift fork groove should not be more than 0.4mm and 0.6mm respectively; the wear of the locating slot of gear lever should not be more than 0.4mm.If the above wear exceeds the specifications, repair by build-up welding.

3.5.5 Synchronizer

If the clearances between lock ring and joint gear end (lock ring type) or between friction cone ring and internal end face of cone disk (lock pin type) is less than the specified one because of wear of spiral slot of friction cone (the inspection of joint clearance of synchronizer gear ring and hub is shown in Fig. 3-6), the synchronizer should be replaced with new one. In addition, if the lock chamfer is worn, repair it by build-up welding, but during machining after welding, the chamfer angle should be guaranteed to accord with the original design requirement.

If the bulge at the middle of the slipping block of lock ring type synchronizer is worn, replace it with new one.

3.6 Disassembly of transmission

3.6.1 Disassembly of transmission assembly

The disassembly of transmission is as follows:

1. Remover the negative pole and the positive pole wires from battery terminals (Fig. 3-7);

2. Remove the backing light switch plug connector of transmission (Fig. 3-8);

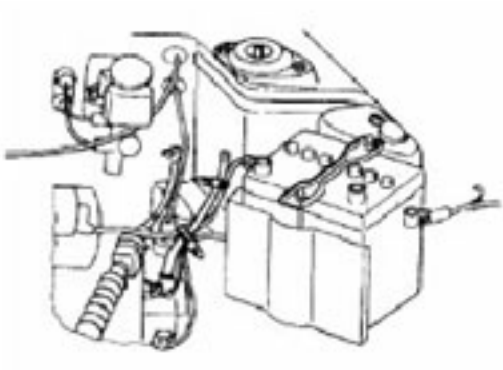


Fig. 3-7 Remove battery wires

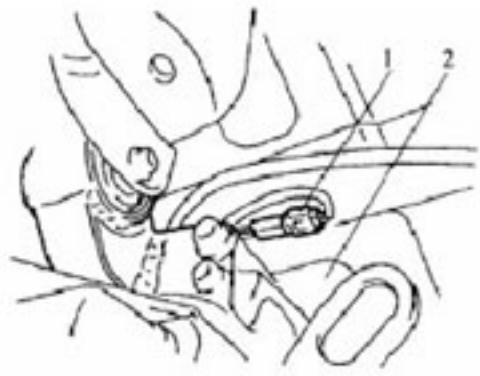


Fig. 3-8 Disconnect backing light switch plug connector

1-backing light switch plug connector; 2-transmission casing

3. Loosen transmission shaft bolt from at drive bridge (Fig. 3-9);

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5. Disassemble the flexible shaft of trip indicator from at transmission extension box;

6. Disconnect connectors of transmission stick and shifting control stick;

7. Remove clutch component pump;

8. Support engine and transmission by bracket, remove transmission suspension bolt and nut respectively;

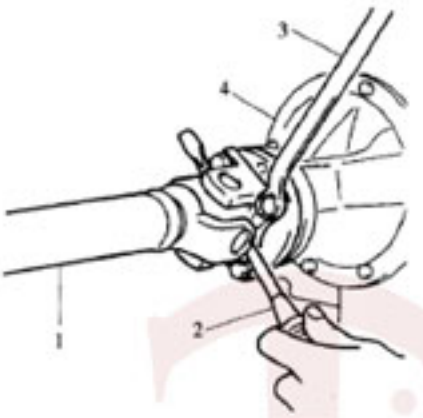


Fig. 3-9 Disassemble transmission shaft

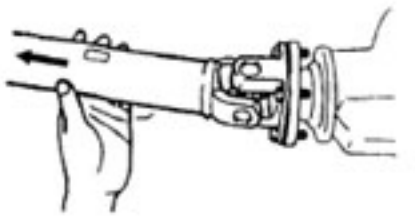


Fig. 3-10 Remove transmission shaft

1-transmission shaft; 2-flat screwdriver; 3-wrench; 4-drive bridge

9. Check and ensure that there is no any connection between transmission and vehicle body, engine and other components, remove transmission and clutch assembly.

3.7 Assembly and adjusting of transmission

There are different assembly processes for transmissions with different structure. During assembly, pay attention their features. Main points, precautions and technical requirements of general assembly and adjusting are as follows:

3.7.1 Assembly of subassembly

Generally, some subassemblies (mainly intermediate shaft, second shaft and transmission cover) need to be assembled before assembly of transmission.

1) Intermediate shaft

Generally, transmission intermediate shaft is a rotating shaft. There is a gear that is connected by a key and interference fits with the shaft. During assembly, pay attention to the position and direction of gear and washer which should be pressed into place by press machine.

2) Second shaft

(1) when assembling constant mesh gears, adjust their axial clearance using washers to make them accord with the requirements of the relevant car model. Generally, it should be 0.10-0.30mm in overhaul and its limit value in use is 0.30mm.

(2) Pay attention to the direction of gear. Especially for tooth sleeve and seat of direct gear, they are often equipped with automatic disengagement proof structure, if the gear is installed reverse, the function will be disabled.

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avoid elevated local temperature and expansion due to friction during operation, resulting in wear and damage of friction conical face.

3) Transmission cover

(1) After installed and fixed with locating pin, the gear lever should rotate smoothly without jamming.



(2) Install special tool for shift fork shaft (Fig. 3-11) to avoid self-locking steel ball from popping out.



(3) Set the firstly installed fork shaft at neutral position and then install other shafts.

Fig. 3-11 Install shift fork shaft by the guide of guiding axle

(4) Don't omit self-lock or interlock balls and their specifications should meet the requirements.

(5) The reverse lock device should meet the requirements. The spherical end of reverse lock pin should flush with shifting block notch or extrude less than 0.5mm.

3.7.2 Technological points and precautions during transmission final assembly

(1) The sequence of final assembly is generally intermediate shaft, back shaft, then the first and the second shafts, and, at last, transmission cover.

(2) The end clearance of back gear, intermediate shaft (fixed axis) fixed cone pulley is generally 0.10-0.35mm and the use limit is 1.00mm.If the clearance is excessively large, adjust it by gaskets.

(3) Check the axial clearances during installation. The axial clearance of the first shaft should not be more than 0.10mm and the clearances of other shafts should not be more than 0.30mm.

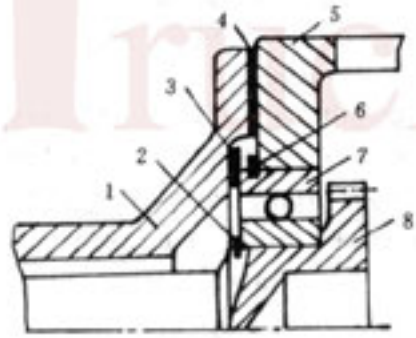


Fig. 3-12 Adjusting of axial clearance of first shaft of transmission

1-bearing cover; 2, 6-clip spring of bearing; 3-metall adjusting gasket; 4-sealing gasket; 5-transmission casing; 7-bearing; 8-first shaft

Generally, the axial positioning of spin axis is realized by the bearing at its one end, so the ideal adjusting status is that bearing cover presses external ring of bearing to guarantee no axial clearance existed. This will not only be beneficial for gear transmission but also reduce the slipping chance between bearing external ring and transmission casing thus reducing wear loss.

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decrease the thickness of sealing gasket 3 of bearing external ring (Fig. 3-12).The principle to determine the thickness of gasket is that, under the premise that there is no oil leakage from bearing cover sealing, press the end face of bearing external ring ad tight as possible, namely, reduce the axial clearance as possible.

(4) The planes of odometer drive gear and the cam of the second shaft should be even to avoid oil leakage.

(5) The normally engaging gear pair between intermediate shaft and the second shaft should align with each other. If they don't align with each other, adjust by adjusting the position of intermediate shaft at the front and the rear end.

(6) For assembled gear transmission mechanism, check whether the gear engagement accords with the requirements;

Engaging clearance: 0.10-0.50mm for normally engaging gear, the use limit is 0.80mm; 0.10-0.40mm for jointing gear, the use limit is 0.60mm.

Engaging impression: should at the middle of gear engaging face and should not be less than 60% of the engaging surface.

(7) When covering transmission cover, check that there should be no any foreign matter remained in the cover, all gears of various stops and shift fork should be at neutral position; after installation, perform engagement test for all stops, there should not be any abnormality.

3.8 Maintenance of transmission

The main work of transmission maintenance is inspection and replacement of gear oil.

3.8.1 Inspection of gear oil

Park the vehicle on horizontal ground and unscrew oil level check plug, check whether the level of transmission gear oil meets the requirements and whether the gear oil is dirty or deteriorated. Replace gear oil if necessary.

3.8.2 Replacement of gear oil

Set transmission gear at neutral position, start engine and engage clutch. Let the engine operate at idle for 3-5min and then stop it and drain out transmission gear oil entirely. Fill flesh gear oil of specified brand with specified quantity.

3.9 Common failures and diagnostics

The common failures of transmission are oil leakage, abnormal sound, automatic disengagement, mixed disengagement, etc.

3.9.1 Oil leakage:

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casing, filler port plug, drain port plug, oil return thread of the first shaft, oil seal of the second shaft (or oil return thread) or bearing cover.

(2) Reason:

□ The jointing plane is deformed or machined roughly;

□ The sealing gasket at the jointing plane is excessively thin, hardened or damaged;

□ The fixing screws at transmission cover, casing side cover and bearing cover are loosened or their tightening sequence doesn't accord with the requirements; □ □ The oil seal and neck journal are misaligned during installation, the oil seal is installed reversely or worn, hardened, or the neck journal is misaligned with shaft;

□ The oil return thread is misaligned with neck journal, there are serious dirty deposits in the groove of oil return thread or there are machining burrs which hinder oil return;

□ The neck journal of oil seal is worn into grooves;

□ Oil filer, oil drain port plug is loosened or its thread is damaged;

□ There are casing defects or cracks.

(3) Diagnostic method: diagnose as the following method. The flowchart is shown in Fig. 3-13.

3.9.2 Abnormal sound:

(1) Phenomenon: the noises of engagement of transmission gear, bearing operating, etc are excessively loud; there are abnormal sounds such as dry grinding, impact, etc from transmission.

(2) Reason:

①. The rolling bearing is lack of oil (for example, the leading bearing of the first shaft); its rolling balls are worn and out of circularity; there are pits, delamination, bruises in raceway; the inner or outer raceway rolls on shaft or in casing, or the clearance between bearing is excessively large;

②. The gear rotates offset or its teeth are deformed because that the machining precision is low or the heat treatment process is improper;

③. The tooth clearance is excessively large or the matching clearance of spline is excessively large;

④. The burrs, projections, etc on the repaired tooth face are not trimmed;

⑤. The tooth face has flakes, delamination, defects, excessive wear or the gears are not replaced by pair;

⑥. The first, the second or the intermediate shafts is bent and deformed;

⑦. After repaired by boring and nesting, the central clearance of the two bearing holes in casing changes or the two axes are not parallel;

⑧. The camber of shift fork after repair is wrong, or the build-up welding at single side is excessively thick

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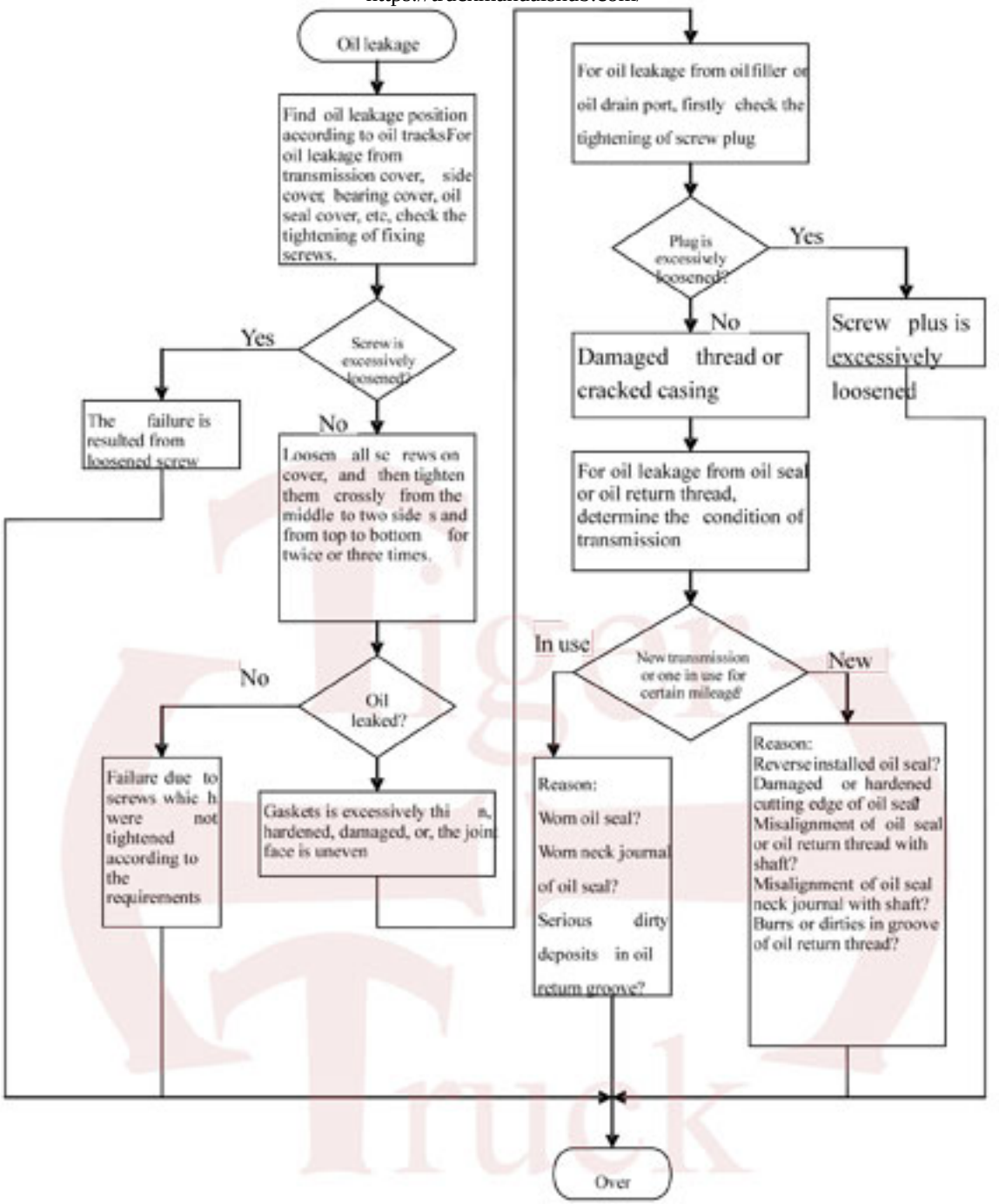


Fig. 3-13 Diagnostic flow chart of oil leakage of transmission

⑨. The fixing nut of the second shaft is loosened or the axial positioning of other shafts is incorrect;

⑩. The groove and steel ball of self lock device are excessively worn, or, the self lock spring is fatigued or broken leading to offset during engagement;

⑪. Individual gear teeth are broken;

⑫. The gear oil is inadequate or deteriorated, or its designation doesn't accord the requirements, or there are odds and ends in the gear oil.

(3) Diagnostic method: diagnose as the following method. The flowchart is shown in Fig. 3-14.

3.9.3 Automatic disengagement:

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automatically from certain stop back to the neutral position.

(2) Reason:

□ The engaging portion of the pair of gears engaging with each other is worn to form conical shape;

□ Because of the change of the position of the hole behind clutch casing, the change of perpendicularity of the jointing plane between clutch casing and transmission casing to the axis of crankshaft, or the bearings of the first shaft and the second shaft are excessively loosened, the first shaft, the second shaft and crankshaft are not on the

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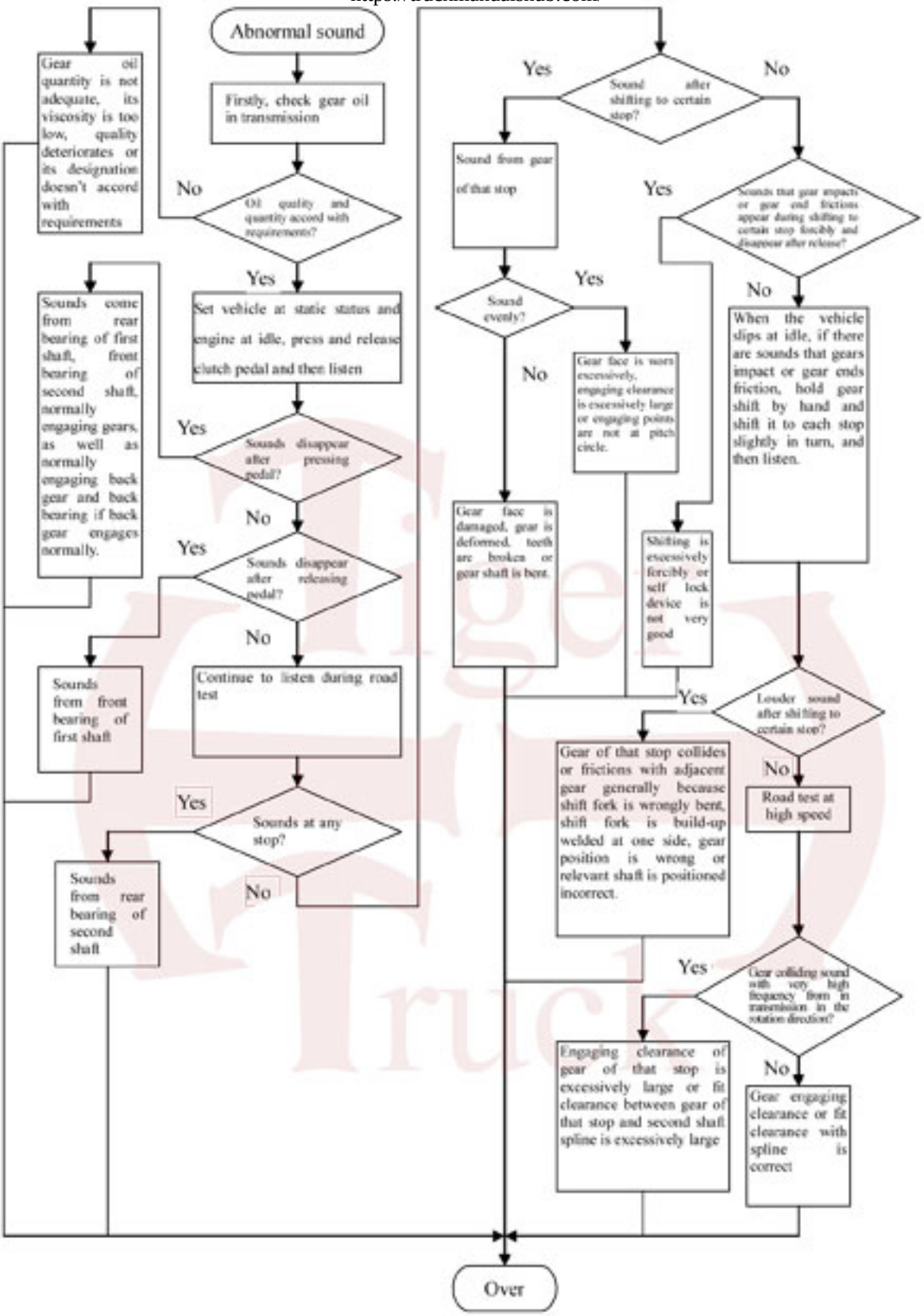


Fig. 3-14 Diagnostic flow chart of abnormal sound of transmission

□ After engagement, the engagement of gear can't reach the whole length of its teeth or the self lock steel ball doesn't enter groove;

□ The axial clearances or the radical clearances of various shafts are excessively large;

□ For transmissions with several normally engaging gears, the axial clearance or radical clearance of the

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□ The groove and steel ball of self lock device is worn seriously, or self lock spring is fatigued or broken.

(3) Diagnostic method: diagnose as the following method. The flowchart is shown in Fig. 3-15.

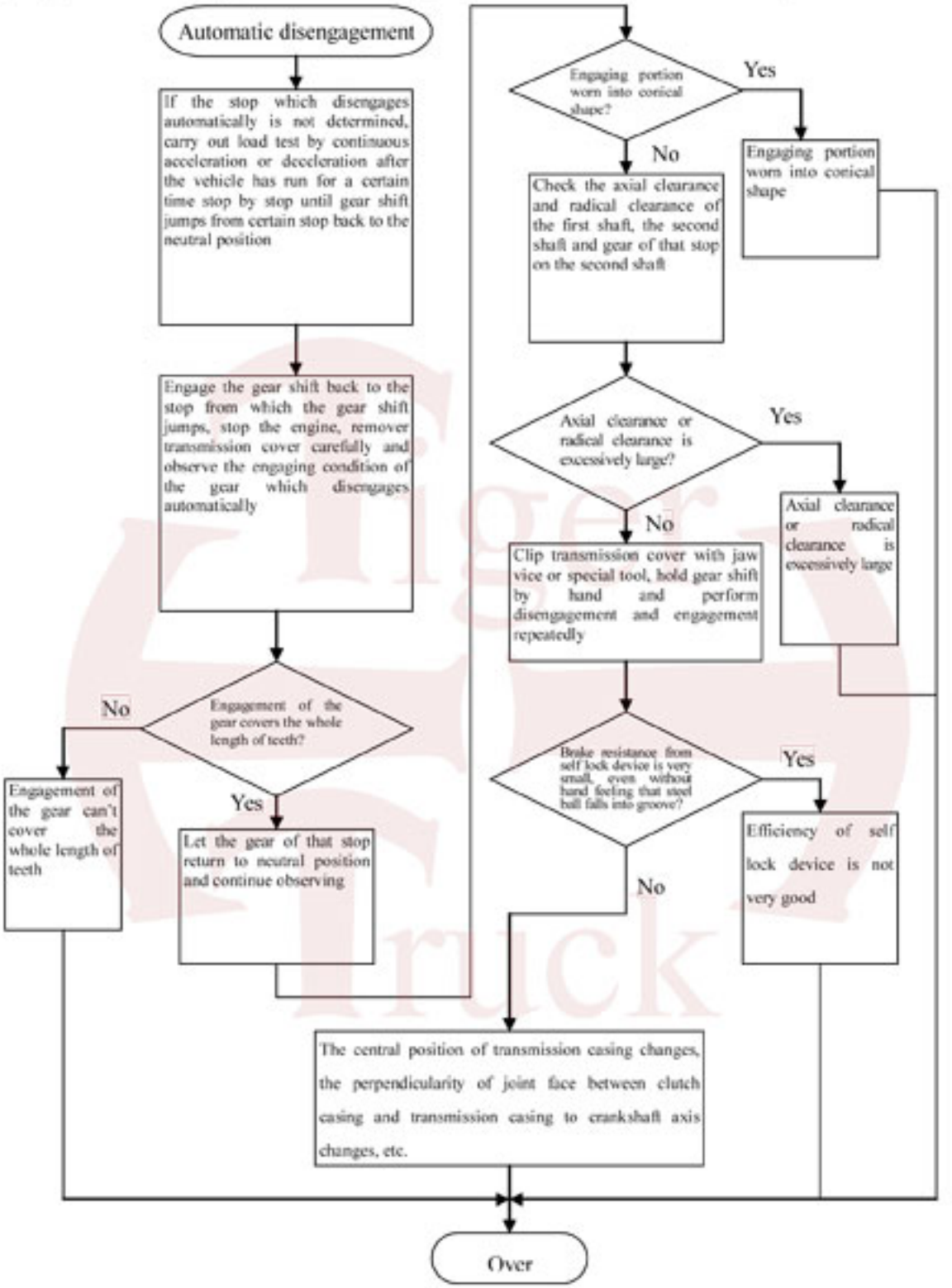


Fig. 3-15 Diagnostic flow chart of automatic disengagement of transmission

3.9.4 Speed disorder

(1) Phenomenon: under the condition that the clutch separates completely, engagement or disengagement can't be realized; engagement for certain speed is performed results in another speed.

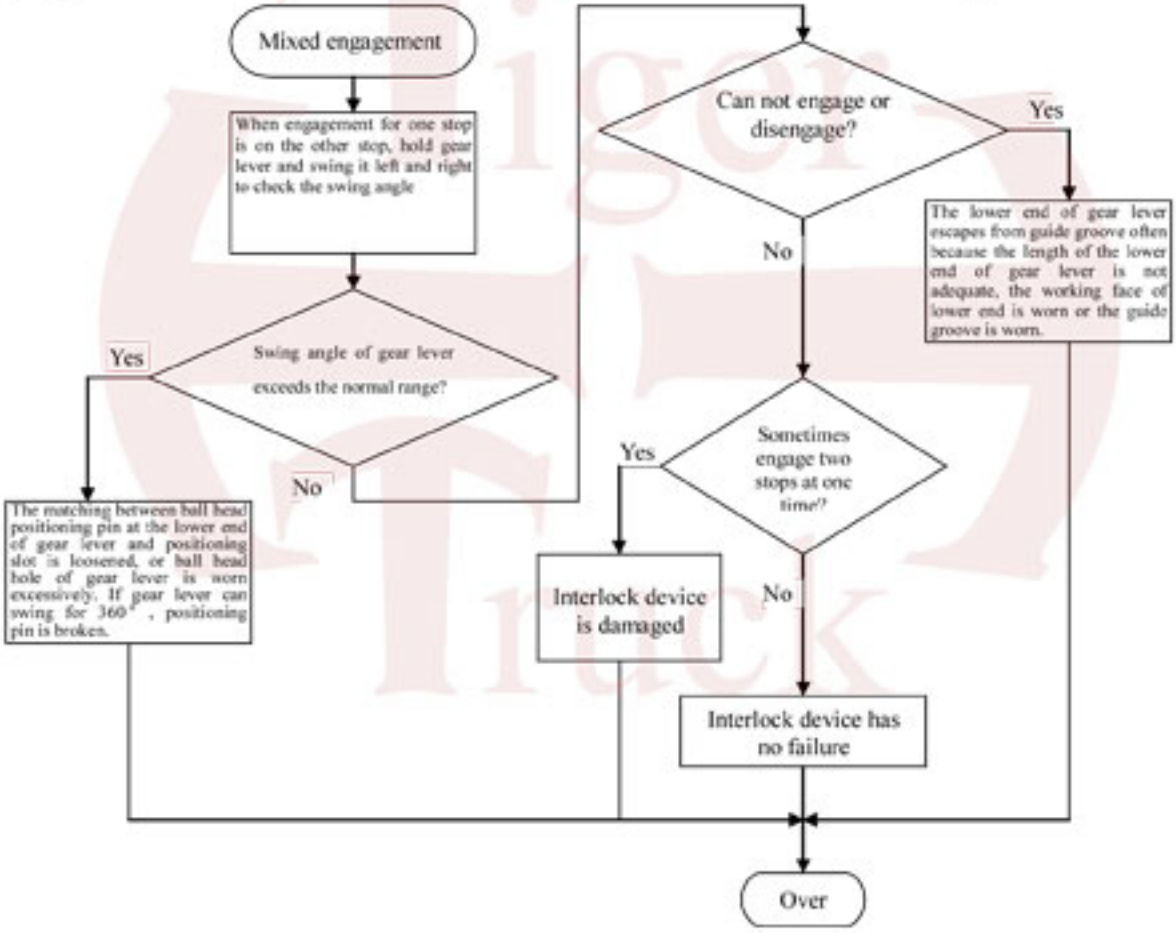
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□ interlock device is damaged;

□ the length of the lower end of gear lever is inefficient, the working surface of the lower end is excessively worn, or, guide slot of guide block on transmission fork is excessively worn;

□ locating pin of ball end of gear lever is loosened or broken, or ball end or sphere hole is excessively worn.

(3) Diagnostic method: diagnose as the following method. The flowchart is shown in Fig. 3-16.



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Chapter 4 Transmission Shaft

4.1 Structure of transmission shaft

The transmission shaft assembly is made up of transmission shaft, front and back universal joints, which is connected to active bevel gear of driving axle and output shaft of the transmitter via flange joint.

Cross shaft of each universal joint is installed with 4 needle roller bearing.

Transmission shaft assembly with double cross shafts can adapt relative displacement of the drive axis to the transmitter caused by change of road conditions and loads to realize constant speed transmission of output shaft of the transmitter and active input gear (Figure 4-1).

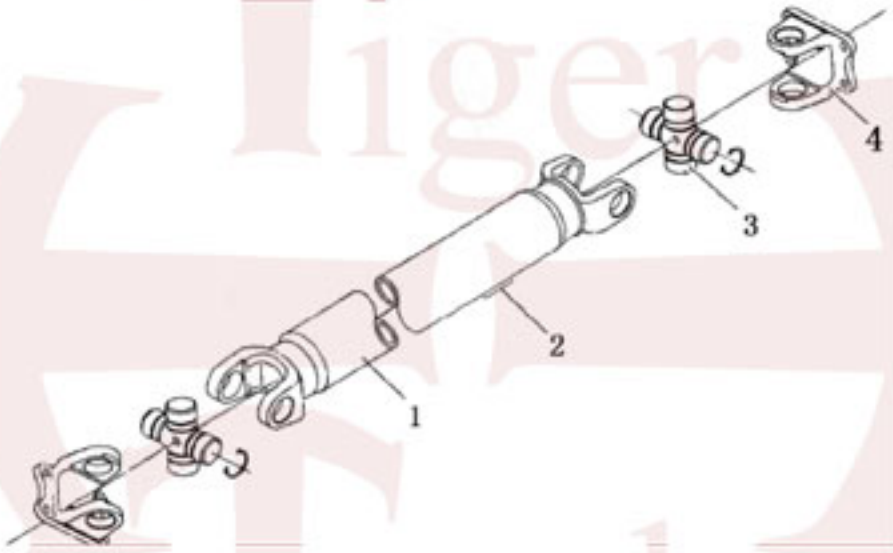


Figure 4 - 1 Transmission shaft assembly

1-Transmission shaft assembly; 2-Balance block; 3-Cross shaft; 4-Flange wrench yoke of universal joint

4.2 Wear analysis of main parts

Wear of the transmission shaft includes spline, cross shaft and bearing, middle support and shaft neck wear and distortion and deformation of the transmission shaft.

4.2.1 Part wear

The spline is one of the main wear parts of the transmission shaft, which is basically one-side wear. After the wear becomes loose, the transmission shaft makes sound in accelerator shifting and the vibration sound from unstable engine revolution from high shift to low shift. Besides, the spline is side centering, for excessive wear, it leads to disalignment of the spline shaft and spline sleeve to cause unbalance and sound is heard, which is increased with increasing of the

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For the cross shaft and bearing perform rotation, the relative speed is very low and the lubricant film is not easy to form. Single-side stress may lead to groove on the shaft neck and the matching clearance is increasing, which is similar with the result of increasing of the matching clearance of the spline.

Looseness of shaft neck and bearing of the middle support of the transmission shaft may cause radial shimmy by non-locating of the rotation axis, with the sound increasing with the revolution.

4.2.2 Deformation of the transmission shaft

Deformation of the transmission shaft includes shaft tube bending, hollow and disalignment of the shaft tube and spline joint. The shaft bending and hollow may be caused by collision of projection on the road or in maintenance. Disalignment of the shaft tube and spline joint is caused by improper welding technology.

The above deformation of the transmission shaft will generate an offset quantity from the rotation axis to break the balance. As mentioned above, when the unbalanced part is rotating, the centrifuge force F will be generated, namely,

$$F = mr\omega^2 = mr(\pi n/30)^2$$

Analyzed from material mechanics, for such slim parts like transmission shaft, the centrifuge force will make the transmission shaft further bended, the bending and deformation will be larger with higher revolution, namely, r is becoming larger. And the centrifuge force is further increasing. The additional load accelerates the support wear and the sound becomes louder with increasing revolution. Such vibration may cause unbearable resonance on the vehicle frame and vehicle body at some revolution.

In addition, sound transmission shaft may generate elastic deformation caused by its own weight and make the mass center deviated from the rotation axis. In the principle, vibration will generate with higher revolution. When the revolution is close to its inherent frequency, resonance will occur, the amplitude increases dramatically and the transmission shaft is finally broken. The said revolution is called critical revolution n_k. For the designed n_k is far higher than n_{max} (Generally $n_k = 1.2 \sim 2n_{max}$), so such phenomena will not occur in general. However, if the transmission shaft is lengthened improperly when refitting the vehicle, n_k is decreasing and such phenomena are likely to occur.

4.3 Check and repair of the main parts

4.3.1 Shaft tube

Radial total run-out of overall length of the shaft tube shall be in line with rules in table 4-1 (0.2mm less for car). When it exceeds the specified values, flame is recommended to calibrate. When pressure is used to calibrate, shape of the pressure head shall match outer diameter of the shaft tube to avoid flattening the shaft tube.

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Length of transmission shaft L	600~1000	>1000
Permissible error	No more than 0.8	No more than 1.0

Note: Length of the transmission shaft refers to the distance from the spline shaft end to axis of bearing hole of the shaft tube yoke.

If there is obvious hollow, severe collision or cracking and etc. on the shaft tube surface, it must be replaced.

4.3.2 Spline shaft and spline sleeve

Radial round run-out of external surface of the spline shaft and shaft neck of middle support of the transmission shaft may not be more than 0.15mm. When it exceeds, cut it off and additional welding is required.

4.3.3 Universal joint yoke

Bearing hole of the universal joint yoke and bearing of the universal joint are excessive matching, when the matching clearance exceeds the specified values, new parts are used to replace.

Matching clearance of cross shaft neck of universal joint and bearing of universal joint shall be in line with rules in table 4-2. If it exceeds the rules, new parts are used to replace.

Matching of cross shaft neck and bearing (mm) Table 4—2

Diameter of cross shaft neck	≤18	>18~23	>23
Permissible maximum clearance	0.08	0.10	0.14

Verticality error of public axis of two bearing holes of shaft tube yoke to axis of transmission shaft shall be in line with rules in table 4-3. When it exceeds rules, cut off the shaft tube and additional welding is required. The verticality error can be detected on the plate with the method indicated in figure 4-2.

Verticality error of public axis of two bearing holes of shaft tube yoke to axis of transmission shaft (mm)

Table 4 — 3

External end surface distance of two holes of tube shaft yoke	≤75	>75~90	>90~105	>105

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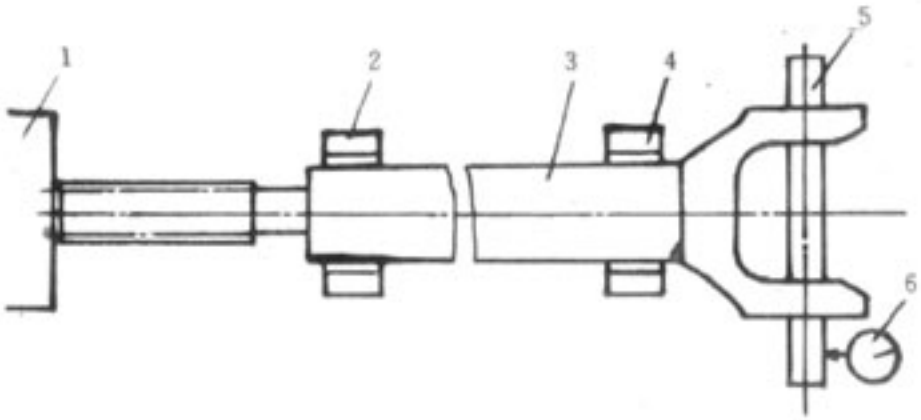


Figure 4-2 Inspection of verticality error of public axis of two bearing holes of shaft tube yoke to axis of transmission shaft

1-Square box; 2, 4-V iron; 3-Transmission shaft; 5-Core shaft; 6-Percent meter

4.3.4 Middle support

If bearing, oil seal and rubber parts of the middle support are damaged, they shall be replaced with new ones.

Matching quantity of bearing of middle support and shaft neck is -0.02 ~ +0.02mm; matching of oil seal and oil seal neck shall be no more than 0.030mm. If it exceeds the above requirements, coating or embedding can be used for repair.

4.4 Balance of the transmission shaft

After overhaul of the transmission shaft, it needs balancing. During balancing, assemble sliding yoke, universal joint and dust-proof sleeve on the specified direction. The dynamic balance test is to be done on professional dynamic balance testing machine. Dynamic unbalance quantity of any end may not be more than values in table 4-4. The welded balance piece on each end may not be more than 3 pieces.

Permissible unbalance quantity of the transmission shaft Table 4-4

Outer diameter of shaft tube of the transmission shaft (mm)	≤58	> 58~80
Permissible dynamic unbalance (g· cm)	30	50

After dynamic balance is realized for the transmission shaft, location marks are done on the sliding yoke and flange yoke to avoid breaking the balance.

4.5 Dismounting and disassembly of the transmission shaft

4.5.1 Dismounting of the transmission shaft assembly

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(2) Assembly mark is done on the connection of the flange yoke of the transmission shaft and flange disc of active bevel gear of driving axle(Figure 4 - 3);

(3) Connection bolt of flange yoke of the transmission shaft and flange disc of active bevel gear of driving axle(Figure 4-4);

(4) Dismount the transmission shaft assembly from the driving axle.

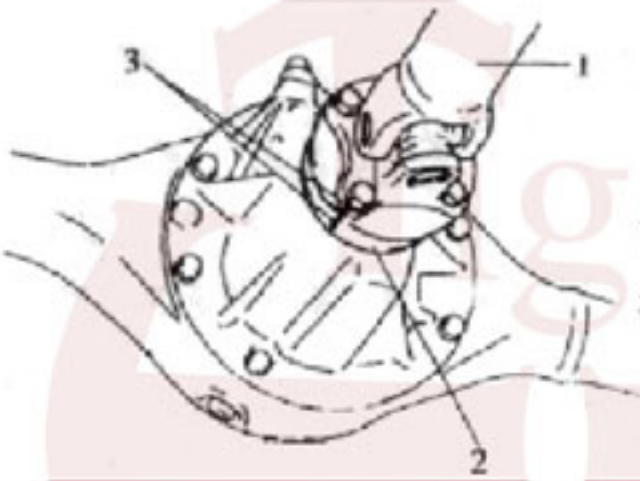


Figure 4-3 Make assembly mark of the transmission shaft
1-Transmission shaft; 2-Flange disc of active bevel gear; 3-Assembly mark

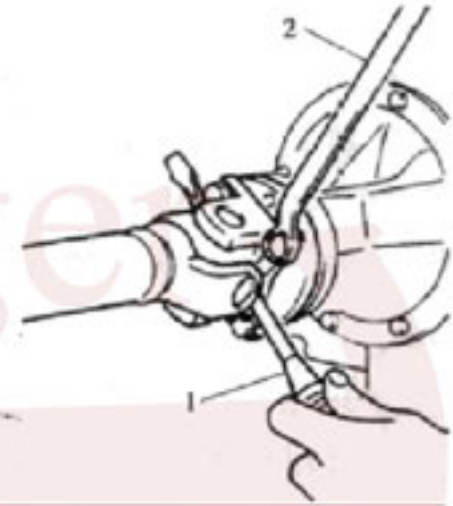


Figure 4-4 Dismount flange yoke bolt
1-Screwdriver; 2-Box wrench

4.5.2 Disassembly of the transmission shaft assembly

(1) Opening ring forceps is used to disassemble two clamp rings of the cross universal joint bearing (Figure 4-5);

(2) Universal joint assembler is used to pull the cross shaft bearing seat ring 3-4mm out from the universal joint yoke seat ring (Figure 4-6);

(3) Knock on the universal joint yoke of the transmission shaft slightly with hammer to disassemble the cross shaft bearing seat ring (Figure 4 - 7);

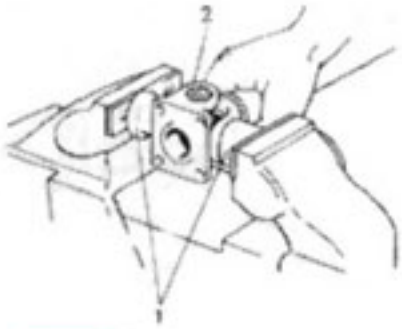
(4) The same method above is used to press the bearing seat ring at the flange yoke side out, then bench clamp is used to clamp the bearing seat ring, knock on the flange yoke slightly to take the seat ring

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Figure 4-5 Disassemble clamp ring of bearing of universal joint

1-Clamp ring; 2-Opening ring forceps



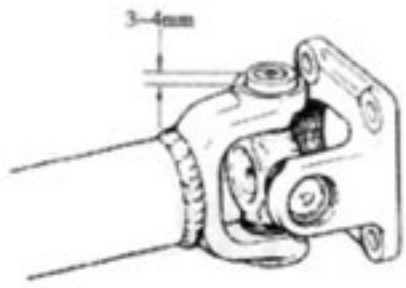


Figure 4 - 6 Disassemble cross shaft bearing

l-Bearing assembler; 2-Flange yoke of universal joint

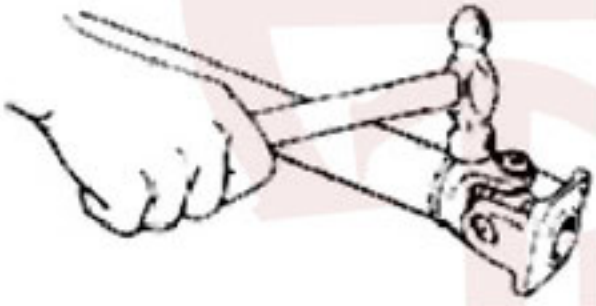


Figure 4-7 Disassemble cross shaft bearing seat ring

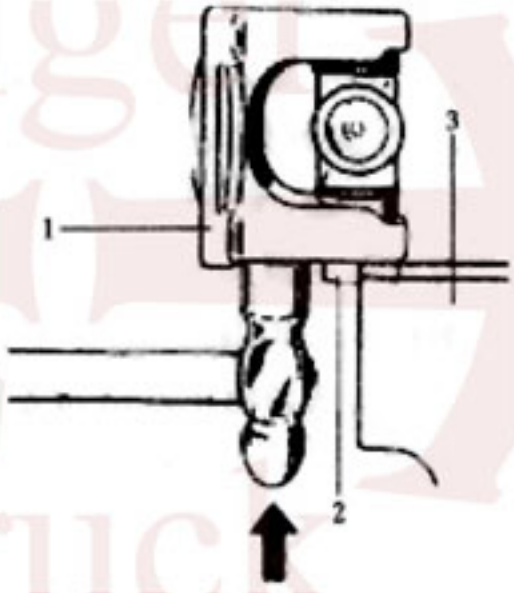


Figure 4-8 Disassemble bearing seat ring at flange yoke side

1-Flange yoke; 2-Bearing seat ring; 3-Bench clamp

4.6 Assembly of the transmission shaft

4.6.1 Lubrication of cross shaft needle bearing (Figures 4-9 and 4-10)

The needle is installed in the seat ring of the cross shaft bearing, and appropriate lubrication grease is coated on the seat ring of the cross shaft bearing and needle.

4.6.2 Assembly of the needle bearing(Figure 4-11)

After 4 needle bearings are coated with lubrication grease, the bearing seat ring is inserted into the universal joint yoke, then the cross shaft is inserted into the bearing seat ring, knock on the needle bearing seat ring with hammer slightly

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Figure 4-9 Lubrication of cross shaft bearing

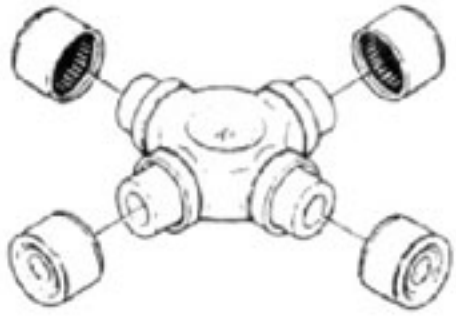


Figure 4-10 Combination of cross shaft and bearing seat ring

4.6.3 Mounting of clamp ring of bearing (Figure 4-12)

After the cross shaft and needle roller are inserted into the universal joint yoke hole, 4 clamp rings are used to fix the shaft and flange of the universal joint.

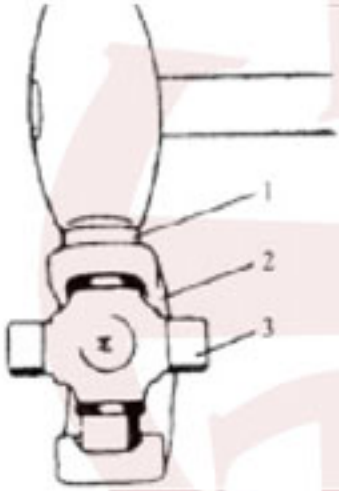


Figure 4-11 Mounting of needle bearing

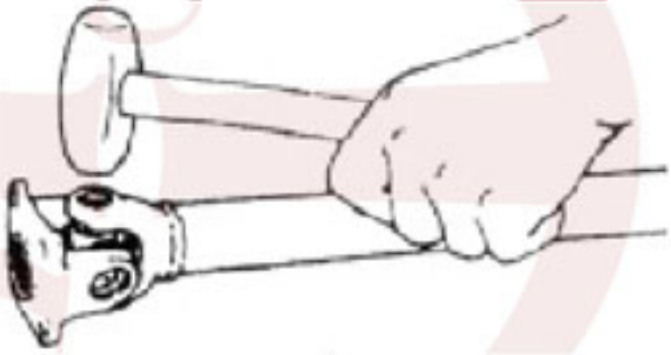


Figure 4-12 Mounting of bearing clamp ring

1-Bearing seat ring; 2-Universal joint yoke; 3-Cross shaft

4.6.4 Mounting of the transmission shaft

Mounting of the transmission shaft is conducted according to the opposite sequence of dismounting. During mounting, assembly mark of flange yoke of the transmission shaft and connecting disc of the active bevel shall be aligned. Tighten the bolt and nut according to specified fastening torque.

Tightening torque of the bolt and nut: 60～80 N· m.

4.7 Troubleshooting and experienced analysis

The common failures are abnormal sound and increasing walking angle.

4.7.1Sounding of universal joint and expansion joint:

(1) Phenomena: when the vehicle starts or changes speed, the transmission device makes an uttering sound; when the

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(2) Causes:

① Looseness of bearing of the universal joint caused by wear or impact;

② Looseness of spline of expansion joint of the transmission shaft caused by wear or impact;

③ Looseness of connecting bolt of flange disc of universal joint.

(3) Diagnosis methods: diagnosis is performed according to the following methods. See the flow chart 4-13.

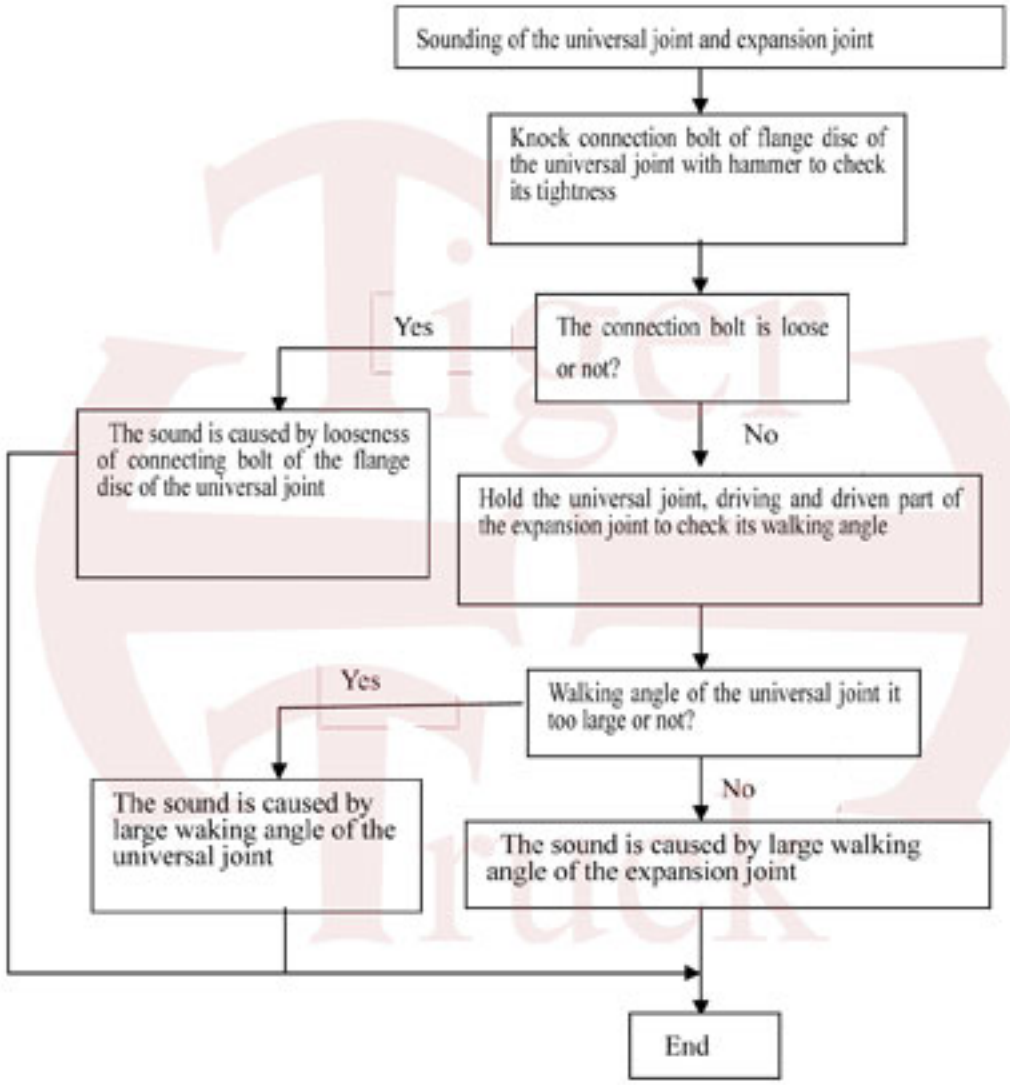


Figure 4-13 Diagnosis flow chart for sounding of universal joint or expansion joint

4.7.2 Sounding of the transmission shaft:

(1)Phenomena: under sound technical conditions of the universal joint and expansion joint, the transmission shaft makes regular sound during traveling of the vehicle, it increases with higher speed. If it is severe, the vehicle body vibrates and even the steering wheel feels numb.

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① Bending of the transmission shaft or hollow of the shaft tube;

② When the transmission shaft tube and universal joint yoke are welding, it is not aligned or dynamic balance is not done for the transmission shaft;

③ Balance piece on the transmission shaft is dropped off;

④ The expansion joint is not installed according to the mark to make the transmission joint lose dynamic balance, or yokes at both ends of the transmission shaft are not on the same plane;

⑤ Looseness of fixing bolt of hanger of the middle support or connecting bolt of flange disc of the universal joint makes the transmission shaft deviated;

⑥ Fastening method of the rubber clamping middle support, which causes front end of the middle transmission shaft away from the original axis.

(3) Diagnosis method: the diagnosis is performed according to the following method. See Figure 4-14.

4.7.3 Sounding of the middle support:

(1)Phenomena: during traveling of the automobile, the vehicle makes "hoot" sound, which increases with higher speed.

(2)Causes:

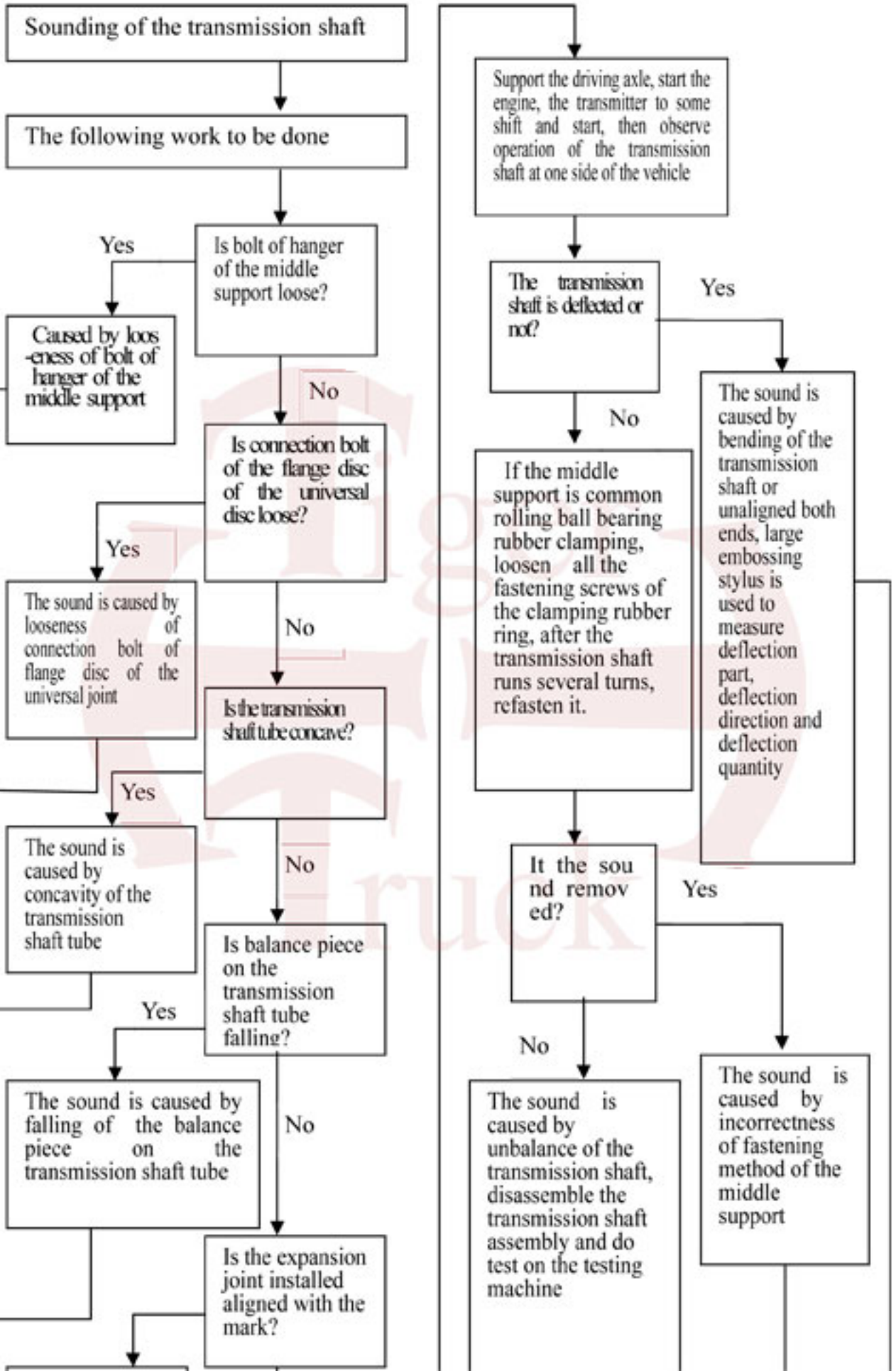
① Scale, spot, excessive wear or oil leakage of the rolling bearing;

② Mounting method of the middle support is not proper, which makes the rolling bearing bear additional load;

③ Damage of the rubber round ring;

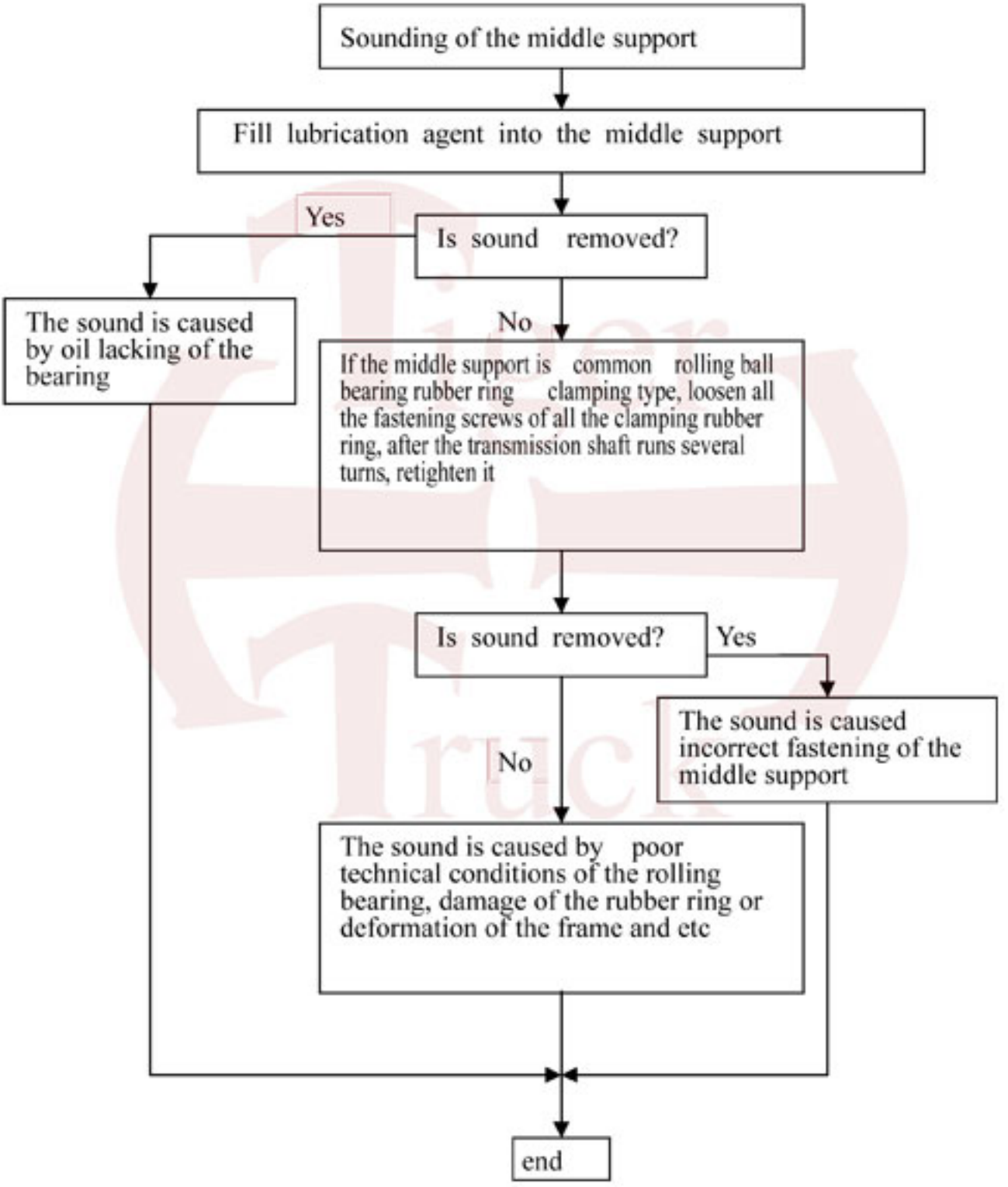
④ Deformation of the vehicle frame.

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Figure 4-14 Diagnosis Flow Chart for Sounding of Transmission Shaft



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4.7.4 Walking angle:

Walking angle of the transmission system is the sum of walking angles of the clutch, transmitter, universal transmission unit and driving axle, therefore, it is also called total walking angle of the transmission system. It represents adjustment and wear of the whole transmission system.

(1)Phenomena: when the automobile starts or the speed changes suddenly, the transmission system makes an "utter" sound; the vehicle is still, the transmitter is on the shift, lift up the clutch pedal, loose the park brake, rotate the transmission shaft with your hand and you can feel there is so much looseness.

(2)Causes:

① Matching of driven piece of the clutch and 1st spline of the transmitter is loose;

② Meshing space of transmission gear of the transmitter is too large or the matching of the sliding gear and spline is loose;

③ Expansion joint of universal transmission unit and the universal joints are loose;

④ Matching clearance of the main reducer and differential of the driving axle and matching of half shaft gear, half shaft gear and half shaft spline and etc.

(3)Inspection methods:

Inspection of walking angle of the transmission angle is divided into sections, and the walking angle of each section is summarized to obtain the total values. The experience is used to check the walking angle, and the angle value can be estimate with experience. The check can be conducted under the circumstances of flameout of hot conditions:

① Inspection of walking angles of clutch and transmitter: The transmitter is shifted on the shift to be inspected, loose the park brake, the clutch is engaged, then rotate output shaft of the transmitter or the park brake disc from one limit location to the other limit location with your hand. Rotating angle between the limit locations is the walking angle from shift of the clutch to output end of the transmitter. After the clutch works for each shift, walking angle of each shift is obtained.

② Inspection of walking angles of the universal transmission unit: lift up the driving axle, haul tight the park brake, then rotate flange disc of the driving axle from one limit location to the other limit location with your hand. Angle between the two limit locations is the walking angle of the universal transmission unit.

③ Inspection of walking angles of the driving axle: loosen the park brake, the transmitter is on idle shift, the driving axle landed or braked, the rotate flange disc of the driving axle from one limit location to the other limit location.

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Sum of the above three walking angles is the walking angle of the transmission system.

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Chapter 5 Axle

5.1 Structure of the driving axle

The cargo carrying vehicle of SC series manufactured by the factory employs integrated driving axle, with high carrying performance and passing performance. The driving axle is located at the end of the transmission system of the vehicle, which is made up of main reducer, differential, half shaft and driving axle shell and etc. The function is: the engine torque from the universal transmission unit is transmitted to the driving wheel via main reducer, differential and half shaft to reduce the speed and increase torque; the bevel gear couple of the main reducer is used to change direction of the torque; the differential is used to realize differential speed of the wheels on both sides ensure different revolutions and directions of the internal and external wheels. See Figure 5-1.

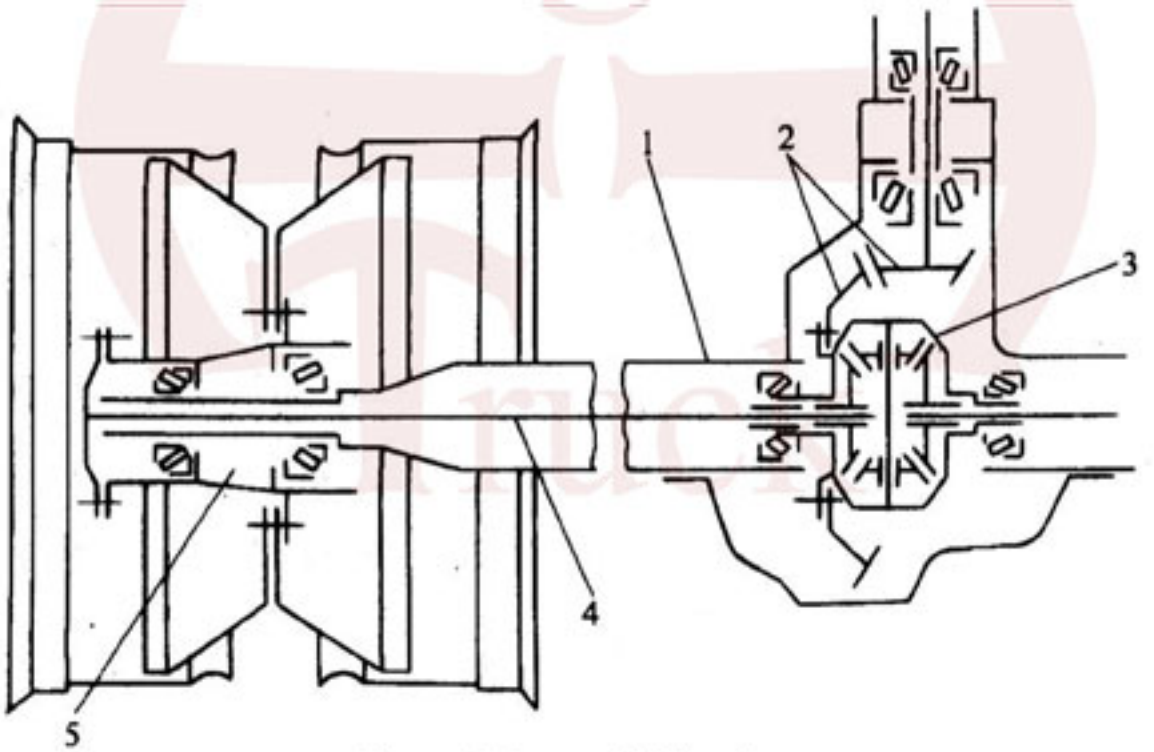


Figure 5-1 Integrated driving axle

1-Driving axle shell ; 2-Main reducer; 3.Differential; 4-Half shaft; 5-Wheelhub

5.2 Main technical specifications

5.2.1Technical parameters of the front axle

Internal inclination of master pin: 7.5°

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External inclination of the front wheel: 1°

Rotating angle of internal wheel: 40°

Rotation angle of external wheel: 32°

Front wheel toe-in: 2mm-4mm

5.2.2 Technical parameters of rear axle:

Wheelbase: 1485mm

Maximum output torque of the main reducer: 8000 N.m

Supporting distance: 940mm

Main reduction ratio: 5.857

Gear oil quantity in main reducer: 2.2 L

5.2.3 Tightening torque of main parts of rear axle

Table 5-1

	Item	Tightening torque N·m
Rear axle	Fastening bolt of bearing cover of differential	120 ~ 170
	Fastening nut of differential shell and driven wheel	80 ~ 100
	Bolt and nut of the half shaft	30 ~ 50
	Bolt of bearing seat of driving bevel gear	90 ~ 110
	Connection bolt of main reducer and rear axle shell	50 ~ 80
	Big nut of driving wheel	210 ~ 240
	Oil level indication and oil discharging plug	130 ~ 150
	Internal nut of rear wheel	≥280
	External nut of rear wheel	≥350
	Fixing bolt for brake bottom plate	50 ~ 80
	Bolt and nut of left and right differential shells	70 ~ 100

5.3 Wear analysis of main parts

5.3.1 Rear shell and half shaft sleeve tube

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driving force) and torsion load transmitted by the main transmitter, additional load by gravity of the main reducer and etc., the stresses are so complicated and there are so many wears. It includes: bending, deformation and cracking of the axle shell; wear and deformation of combination plane of the axle shell and main reducer shell; wear of excessive combination of the half shaft sleeve tube and the axle shell; wear of shaft neck of bearing of wheel hub of half shaft sleeve tube and the matching part of bearing of external end of semi-floating half shaft and etc.

Bending and deformation of the axle shell make bending alternating stress on the half shaft which causes tiredness and cracking, meanwhile, the wheel generates internal inclination and toe-in (or negative toe-in), which accelerates wear and leads to abnormal wear.

The half shaft sleeve tube and axle shell are excessive matching, owing to micro-motion wear, the outmost shaft neck is most likely to be loosed, and it is hard to find out if we do not pull the sleeve tube out. After the matching clearance becomes larger, depending on the second outmost shaft neck support, the suspension arm is lengthened to make the support toughness reduced. At this time, the following may occur: when the wheel is overhead, the brake clearance is done; after the wheel is placed down on the ground, it is hard to brake. The cause is that when the wheel will not take the force, after it is placed on the ground, reaction of supports makes the half shaft bend upwards to reduce clearance at the lower part of the wheel brake.

Cracking of the axle shell is generally on the steel plate base with maximum bending torque and brake bottom plate with collective torsion stress.

5.3.2 Main reducer shell

Main wear of the main reducer shell

Main wear of the main reducer is wear of the bearing hole, location error between the axis and axis, axis and the plane location error out-tolerance. Especially verticality and position tolerance of axis of the driving and driven bevel gears affects most on reliability of the main reducer. When the error is excessive, there should be no correct meshing mark and meshing clearance, which causes non-conformed meshing mark and reduced area. It dose not only make noise, but also shortens service life of the gear for collective stresses.

5.3.3 Half shaft

Main wear of the half shaft includes wear, distortion and breaking of the spline. For the half shaft spline is the one bearing the maximum torque, with big wear and distortion. Breaking of the half

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5.4 Repair of main parts

5.4.1 Axle shell and half shaft sleeve tube

The integrated axle shell takes shaft neck on both ends as basis, with parallel degree error of the front end surface no more than 0.30mm and 0.40mm (diameter of the front end surface will not be more than and more than 300mm respectively), radial jumping of the external shaft neck shall be no more than 0.30mm. The sectional axle shell takes combined cylinder surface, combined plane and internal cone on the other end as support, radial round jumping of the internal and external shaft neck shall be no more than 0.25mm. End surface round jumping of the combined plane of the axle and reducer shall be no more than 0.10mm and 0.08mm (diameter of the combined plane shall be over and no more than 200mm respectively). Radial wear of the oil seal neck of the axle shall be no more than 0.15mm. Matching of the axle and half shaft sleeve tube shall be in line with the original design rules. Matching of the sleeve tube shaft neck and bearing shall be in line with the original design rules.

When it exceeds the above rules, the plane can be repaired by scraping or grinding, the shaft neck can be repaired by galvanization, coating or surfacing welding. After repair, the radial round jumping shall be no more than 0.08mm. The oil seal neck can be repaired with surfacing welding.

End surface round jumping and radial round jumping of combination plane of the axle shell and brake hub chassis and cylinder surface to axle shell axis shall be no more than 0.10mm. Otherwise, flange of the axle can be repaired by grinding.

In case of deformation of the axle shell, it can be calibrated with pressure or flame. If heat pressure is used to calibrated, the heating temperature shall be no more than 700℃.

5.4.2 Main reducer shell

Matching of holes on the shell and the bearing (or the bearing cap) shall be in line with the original design rules. It is interference, and the limit may not exceed a matching clearance of 0.02mm.

Co-axial degree of holes of the left and right bearings of the differential may not exceed 0.10mm.

Parallel error of the cross shaft support hole axis of the reducer to the front end surface may not be

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Verticality error of the longitudinal axis to the cross axis shall be no more than 0.16m and 0.12mm (the longitudinal axis length shall be more than and no more than 300mm). The longitudinal and cross line shall be at the same plane (in addition to the hyperbola gear structure) and the location error may not be more than 0.08mm.

If it exceeds the above requirements, it can be repaired by replacement or embedding.

5.4.3 Half shaft

Crack detection shall be done for the half shaft, if there is any cracking, it must be rejected.

There should be no evident torsion on the half shaft spline, otherwise, it must be rejected. Clearance of the spline gear side may not be more than the original design rules 0.15mm, otherwise, it may be rejected or repaired by surfacing welding.

Take the spline axis as basis, radial round jumping for the unprocessed part in the middle shall be no more than 1.30mm, radial round jumping of external cylinder surface of the spline shall be no more than 0.25mm, round jumping of the internal side end surface of the flange of the half shaft shall be no more than 0.15mm. When it exceeds the rules, pressure calibration and end surface grinding can be used for repair.

5.5 Assembly and adjustment of the steering axle

To ensure correct and reliable connection of the parts, the following points shall be paid attention to:

(1) Before installing the main pin, the standard adjustment washer must be selected to make the clearance between the upper end surface of the front shaft and the steering joint in line with the standard;

(2) When installing the main pin and thrust bearing, add lubrication grease in the lining and bearing. The thrust bearing is installed in the concave seat of the steering joint with opening downwards, and wood hammer is used to knock the main pin into the main pin hole;

(3) After locking inserting hole of the cross pin of the main pin, nut on the cross pin shall be tightened to specified torque, at this time, exposed length out of the hole of big head of cross pin shall be no less than 2mm;

(4) To protect transition round corner at root of the finger shaft of the steering joint, internal chamfering of the assembled oil seal ring or spacing ring may not be less than the transition round

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(5) Nut is used to adjust matching clearance of the internal and external bearings of the wheel hub, the bearing shall be free of evident axial clearance to make rotate evenly.

5.6 Assembly and adjustment of the driving axle

Assembly and adjustment of the driving axle includes assembly and adjustment of the main reducer and differential and assembly and adjustment of the wheel hub. The key point is assembly and adjustment of the main reducer. The adjustment is the key for quality of assembling. In addition, adjustment of the main reducer and wheel hub bearing is one the key maintenance jobs for vehicles.

5.6.1 Assembly and adjustment key points for the differential

(1) When the driven gear is fastened on the differential shell with bolt, the bolt shall be tighten symmetrically with specified torque to avoid deformation. After fastening, check round jumping error of back of the driven gear, which shall be no more than 0.10mm;

(2) The side with oil channel of gasket of the gear of the half shaft shall aim at the half shaft gear;

(3) The planet gear shall operate smoothly and freely. Meshing clearance of the planet gear and half shaft gear shall be in line with the original design rules; when it exceeds the rules, it can be adjusted by replacing the thrust gasket or replacing the gear.

(4) When assembling the differential shell, please aim it at the assembly mark.

5.6.2 Assembly and adjustment of the main reducer

Assembly and adjustment sequence of the main reducer is before the total assembly, then adjust pre-tightness of bearings of the driving and driven gears, then adjust meshing mark and clearance during assembly. In addition, if there is a thrust device on the back of the driven bevel gear, the thrust device needs to be adjusted. For double-level main reducer, assembly and adjustment of the second reduction gear can be done.

(1)Adjustment of pre-tightness of the bearing

①The torque of 150～180N·m is used to tighten the nut of the wheel hub bearing, meanwhile, rotate the wheel to make the bearing roller at correct position;

□Loosen the nut of the wheel hub bearing about 1/4-1/3 turns to make cylinder on the internal nut

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□The torque of 150 ~ 180N·m is used to tighten the external nut, rotate 2-3 turns, then the opening pin is inserted;

□Cutting force at the wheel hub bolt shall be 25 ~ 35N. At this time, the wheel hub can rotate freely without axial displacement and swinging.

Notes:

When maintaining the wheel hub, it shall be assembled or disassembled smooth to prevent cutting edge of the oil seal from damaging.

Do not make external seat ring of the oil seal lost.

When replacing internal of the wheel hub, the two edge sealed with oil shall be coated with thin lubrication grease.

After the wheel hub is adjusted, pay attention to temperature of the wheel hub in the first 10Km travel, such as heating. It means that the bearing is over-tightened and it needs re-adjusted.

(2)Adjustment of the main reducer

Main reducer of the rear axle is to increase the torque from the transmitter to reduce revolution and the torque is distributed to the left and right wheels. Bevel gear of main reducer of the rear axle and bearing have been selected and adjusted before leaving the factory, under general circumstances, it does not need to dismount and adjust. When the gear is worn, clearance at the gear side and axial clearance of the bearing is excessive or evident abnormality or damaged parts,

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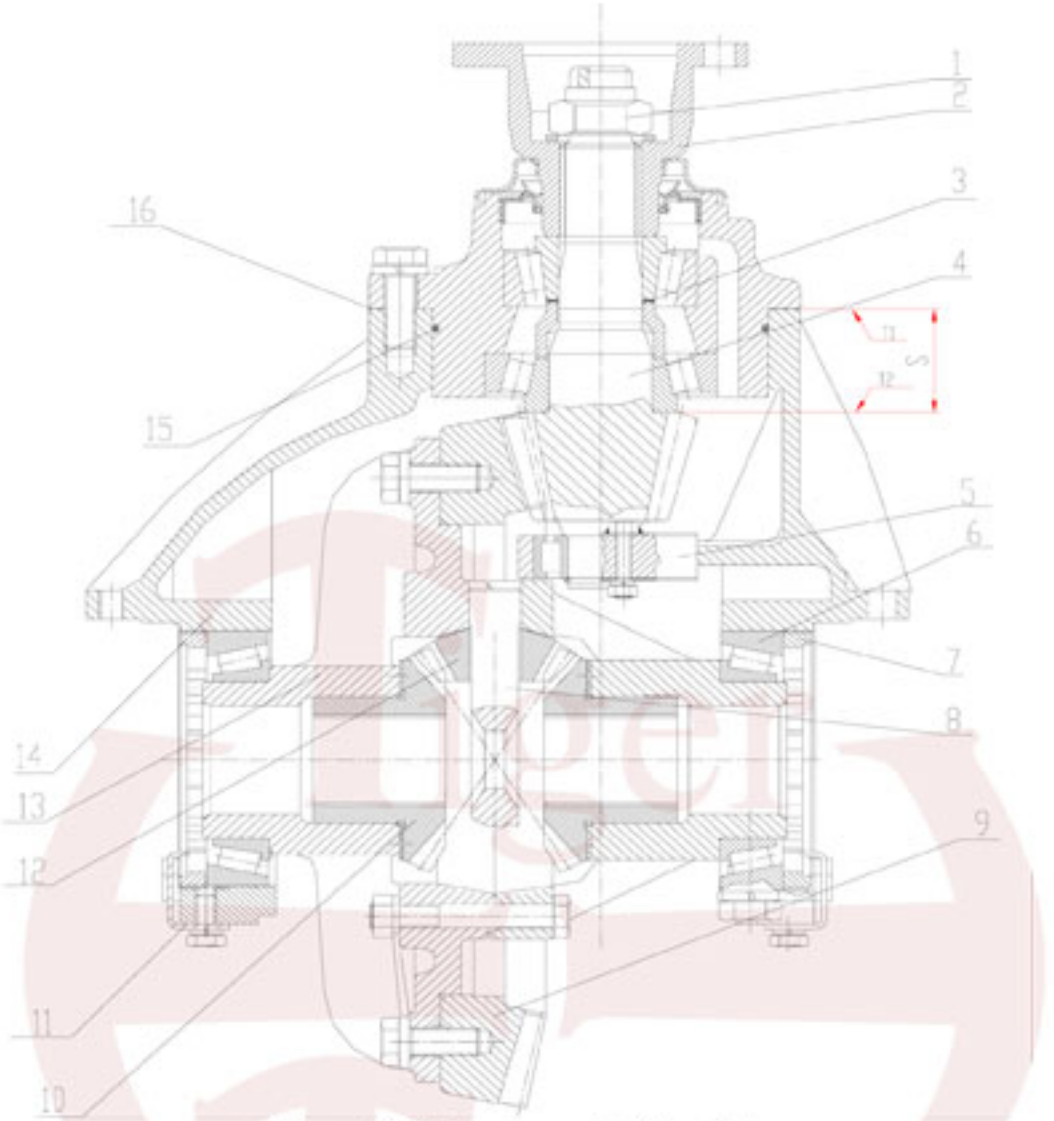


Figure 5-2 Main reducer and differential

1-Main cone locking nut; 2-Flange; 3-Adjustment gasket; 4-Main cone; 5-Rear bearing; 6-Differential bearing; 7-adjustment nut; 8-Cross shaft; 9-Driven bevel gear; 10-Half shaft gear; 11-Locking piece; 12-Plantary gear; 13-differential shell; 14-Reducer shell; 15-Seal ring; 16-Adjust gasket

1) Adjustment of pre-tightness of bearing of the main reducer

a Dismount the rear axle from the transmission, then the torque of 210 ~ 240N·m is used to tighten the flange nut 1, then the hand is used to pull the flange 2, it should be no clearance, otherwise, it needs adjusting.

b Adjustment of bearing clearance of the main reducer is realized by adjust the gasket 3 between inner ring of the two bearings. After adjustment, the force of 1.5 ~ 2.5N·m can be used to rotate the driving bevel gear by the flange 2 inner holes.

c Adjustment of pre-tightness of the differential bearing is realized by tightening nut of the differential bearing with a torque of 130 ~ 150N·m, without axial displacement and the

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different shell, all the screws must be cleared and fastening gel is coated for the screws (Kerui 271 screw fastening gel is used).

2) Adjustment of tooth surface meshing and tooth clearance of the main reducer

Note: if there is a great difference in adjacent teeth of the driven gear in the contact area, the driven and driving bevel gear shall be changed until it is the same.

a The tooth surface meshing employs both-side coating method to inspect on the driven bevel surface, requiring the meshing mark in the middle and close to the small end and tooth top, with length 60% of width of the tooth surface and 1.5mm away from the tooth top in height. Adjustment of the mark is realized by increasing or decreasing adjustment gaskets between the driving bevel gear bearing seat and the main reducer shell, with thicknesses of 0.1, 0.15, 0.30 and 5mm and the surface shall be flat and smooth.

b The tooth clearance is 0.15 ~ 0.30mm and change of the clearance at the gear side may not be more than 0.10mm, which is realized by adjusting differential bearing nut to move location of the driven bevel gear. If the clearance is more than the specified values, the driven bevel gear shall move to the direction of the driving bevel gear, otherwise, it will move in a reverse direction. To ensure constant pre-tightness of the differential bearing, the in and out quantity of the adjustment nuts of both ends must be consistent.

Note: if there is a great difference in adjacent teeth of the driven gear in the contact area, the driven and driving bevel gear shall be changed until it is the same.

Table 5-2

Gear contact area			Adjustment
Convex	Concave	Appropriate	No adjustment
		Too close driving and driven gears	Small clearance, loosen the left side, fasten the right nut
		Too far driving and driven gears	Big clearance, loosen the right side, fasten the left nut
		High contact area of the driving and driven gears	Far space of driving and driven gear (reducing gasket)
		Low contact area of the driving and	Close space of driving and driven gear

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5.7 Maintenance of the axle

1 . Before checking the front and rear axles, tighten the main torques of fastener and lubrication grease shall coat lubrication grease on it.

2 . After assembling, the front and rear axles shall perform a break-in operation of 1000Km. In the 200Km travel, the vehicle shall be without load. In the 200-1000Km travel, check temperature of the wheel hub, if it is heated, it is tightened by the bearing and it needs adjusting.

3 . After the break-in period, check fastening of the nuts, add lubrication oil on the upper and lower parts of the steering joint as well as the cross straight pull rod ball pin.

4 . Maintenance of rear axle

(1) During normal travel and maintenance, clear oil dirt and dust in the ventilation hole of the rear axle shell to ensure smooth venation. After the ventilation hole is blocked, pressure in the rear axle shell will be increased, which leads to oil leakage at the joint.

(2) When maintaining, check lubrication oil surface in the rear axle shell to add or replace the lubricant. The 18# hyperbola fraction gear oil must be used, otherwise, the tooth surface will be worn.

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bearing, clean main pin of the steering joint, the cross straight pull rod ball is added with lubrication grease, check oil level of the reducer and adjust the toe-in. Check fastening of the bolt and nut and adjust the brake clearance.

6 .50000km for second-level maintenance: dismount and adjust the main reducer, differential, and clean and replace the oil, dismount and check the wheel brake, there should be no wear, aging and deformation on the pump leather cup, check and dismount the steering joint and cross straight pull rod joint.

7 . Lubrication oil and lubrication grease

Table 5-3

Maintenance	No.	Lubrication part	Lubrication grease
4000km	1 2	Main pin of the steering joint Ball pin of cross pull rod	
8000km	3	Check oil level of the main reducer, if necessary, add 18# fraction hyperbola gear oil	
12000km	4	Wheel hub bearing	Lithium-base lubrication grease
24000km	5	Replacement of rear axle gear oil	18# fraction hyperbola gear oil

(1) Sulfur and phosphorous middle load (GL-4) or heavy load (GL-5) vehicle gear oil and 18# fraction gear oil is recommended for rear axle.

(2) Lubrication grease: lubrication grease is used for the wheel hub and lubrication points, GM lithium grease meeting GB5670-85 requirements for vehicle is recommended.

5.8 Troubleshooting and experience analysis

Failures of the driving axle is oil leakage, overheating and abnormal sound.

5.8.1 Oil leakage.

(1)Failure: obvious oil leakage mark can be seen from the oil adding faucet, oil discharging faucet, oil seal or the combined surfaces.

(2) Causes:

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□ Co-axial oil seal and oil neck, opposite oil seal, wear or hardening of the oil seal;

□ Oil seal shaft neck to be grooved;

□ Deformation of the combined surface or coarse processing;

□ Seal gasket at the combined plane is too thin, hardened or broken;

□ Looseness of fastening screw at the two combined surface or fixing method of the screw not conformed;

□ Block of the ventilation hole;

□ Casting defect or cracking on the axle shell

(3) Diagnosis method: diagnosis for oil leakage of the driving axle is the same as the method for oil leakage of the transmitter. Refer to relevant content.

5.8.2 Overheating

(1) Failure: after traveling some miles, touch middle of the driving axle shell, the heating is unbearable;

(2) Causes:

□The gear oil is not sufficient, worsening or non-conformed brand;

□The cone rolling bearing is too tightened;

□Meshing clearance of bevel gear of the main reducer is too small;

□Meshing clearance of planetary gear of the differential and half shaft gear is too small;

□The oil seal is too tightened;

□Back clearance of the thrust gasket and driven gear of the main reducer is too small.

(3) Diagnosis: it is performed according to the following method. See Figure 5-3 on the flow chart.

5.8.3 Abnormal sound:

(1) Failure: when the vehicle drives at some shift, the driving axle makes loud sound, when the vehicle drives without power or at low speed, the sound is reduced or disappeared; when the vehicle drives and run without power, the driving axle makes loud sound; when the vehicle turns, it makes loud sound, and drive in a straight line, the sound is reduced or impaired; when the

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speed, the driving axle makes "goggle" sound.

(2) Causes:

□Damage, severe wear or excessive looseness of the rolling bearing;

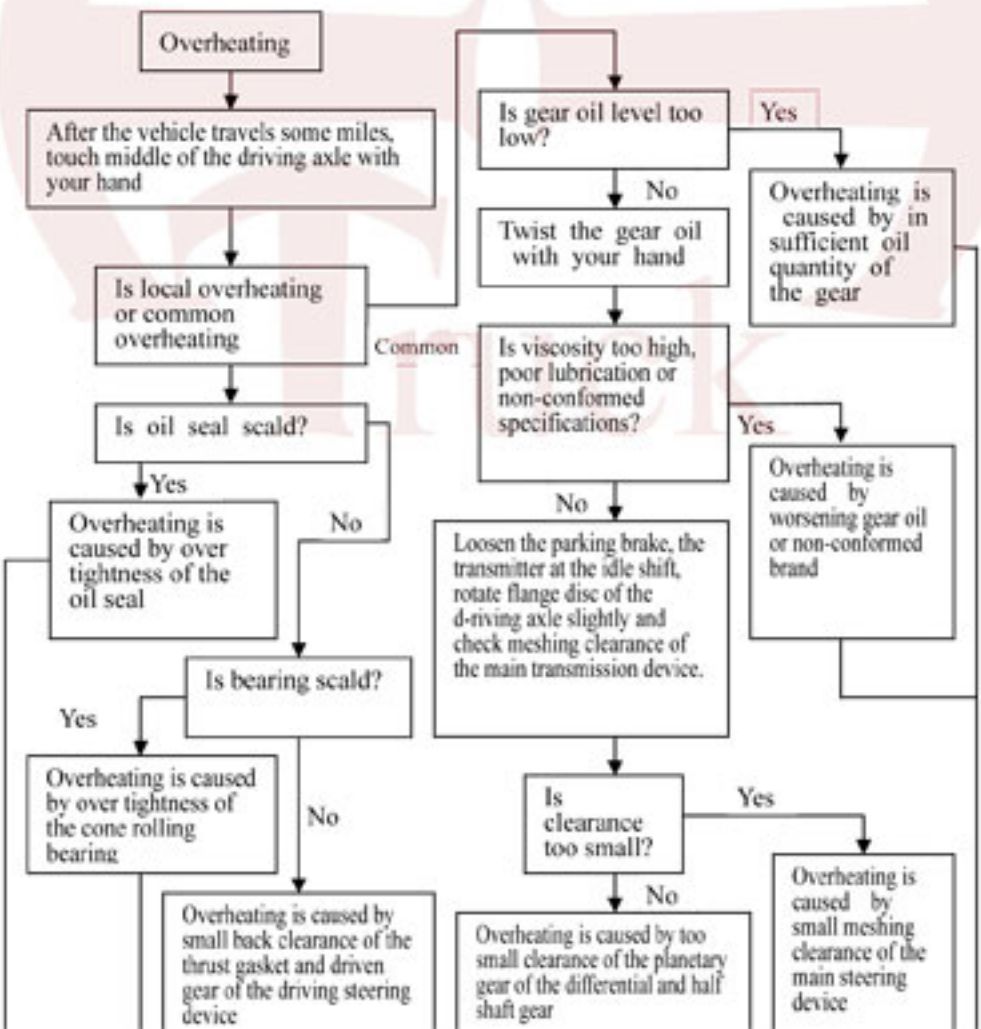
□Severe wear of bevel gear of the main reducer, gear deformation, tooth broken, inappropriate adjustment of the meshing surface, too small or big of the meshing clearance, uneven meshing clearance or not replaced in couple;

□Deformation of driven gear or looseness of connection of main reducer;

□Looseness of fastening nut of flange disc of driving gear of the main reducer;

□Deformation of shell body of the main reducer or shell of the differential;

□Loose of matching of differential and cross shaft;



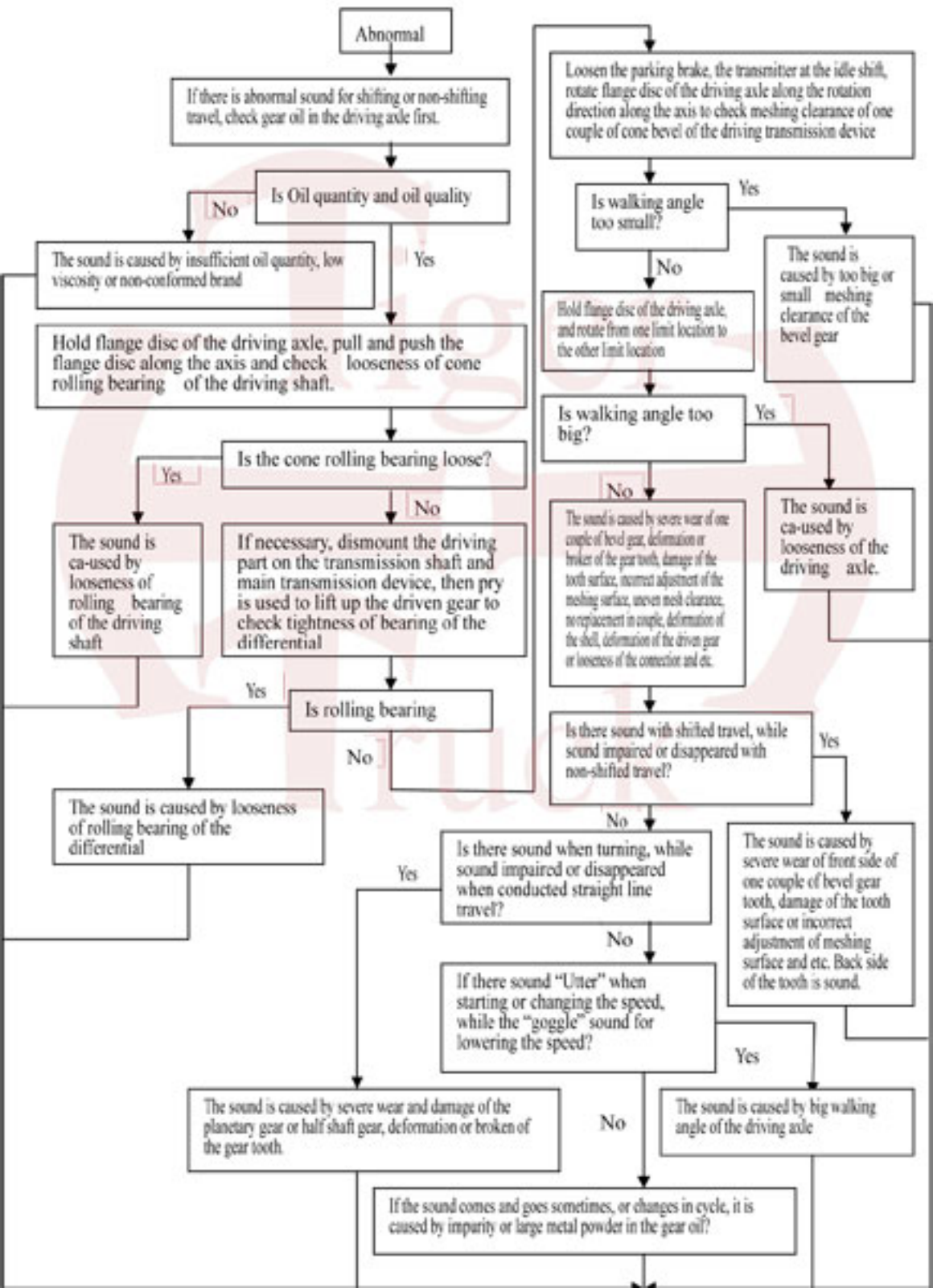
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Figure 5-3 Flow Chart for Overheating Diagnosis

- Looseness of matching of the planetary gear hole and cross shaft, too small or too big meshing clearance with the half shaft gear, severe damage, deformation or cracking of meshing surface with the half shaft gear;
- Looseness of matching of half shaft gear or half shaft spline;
- Insufficient gear oil, small viscosity or non-conformed brand;
- Dirt or metal powder in the gear oil

(3)Diagnosis method: it is conducted according to the following method. See Figure 5-4 on the flow chart.

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Chapter 6 Suspension

Suspension is the general name of all the force transmission devices between the important frame and axle in modern vehicles. It is used to transmit all the forces and torques between the frame and wheel; relieve impact load to the frame from the road as well as the vibration to ensure smoothness of the travel; ensure ideal moving features on uneven road and changed load; ensure stable operation of the vehicle and high travel capability.

The cargo carrying vehicle manufactured by the company employs non-independent suspension of vertical-laid steel plate spring as the front and back suspension, which are made up of steel plate spring, shock absorber and buffering block. In the following, we will introduce maintenance of the steel plate and shock absorber.

6.1 Sketch map of the suspension structure

See Figure 6-1 on non-independent suspension of vertical-laid steel plate spring.

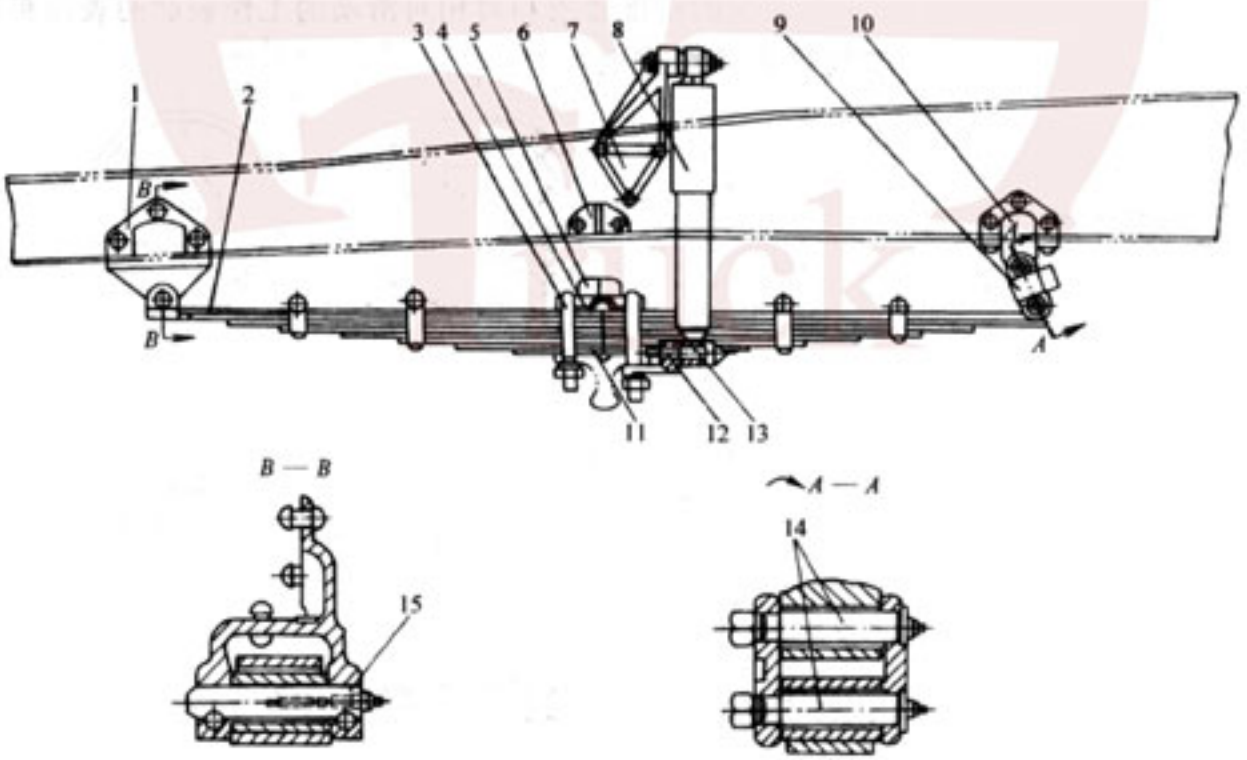


Figure 6-1 Non-independent suspension of vertical-laid steel plate spring

1-Front frame of the steel plate spring; 2-Front steel plate spring; 3-U bolt; 4-Cover board of the front board spring; 5-Buffering block; 6-Limit block; 7-Upper frame of the shock absorber; 8-Shock absorber; 9-Lifting eye;

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6.2 Main technical parameters of suspension

		YND485Q	490QB, 490QZL	4100QB, 4100QB - 2
Suspension model		Non-independent suspension of vertically-laid steel plate spring		
Number of plate spring	Front	6	7	8
	Back	6+1	6+4	7+5
Arc height for full load	Front (mm)	31.5	8.5	-5
	Back (mm)	3	-5.5	51.5
Length of plate spring	Front (mm)	1255	1240	1240
	Back (mm)	1345	1400	1415
Shock absorber	Model	Bi-directional tube type shock absorber		
	Maximum length (mm)	477		
	Minimum length (mm)	287		
	Stroke (mm)	190		
	Shock absorption force - Extension (N)	2000±150		
	Shock absorption force - Contracting (N)	700±50		

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When disassembling the suspension, the front and back axles. For the non-independent suspension of vertical-laid steel plate spring is simple, you only need to dismount connecting bolt between the plate spring and axle body, the absorber and axle body and frame.

Inspection of the suspension:

1. Check the absorber is oil leakage or out of shock absorption and if there is any cracking or fault welding of the lifting eye and tube. If there is any non-conformity, replace the absorber assembly.
2. Check if there is any looseness and breaking on the bolt in the center of spring, the reed is displaced or not, any cracking on the reed; if there is any non-conformity, it must be repaired or replaced.
3. Check if there is any damage or deformation on the rear lifting eye and shaft pin bolt of the steel plate spring, if any, it shall be replaced.
4. Check if there is any cracking on U bolt and screw and any damage on the screw; if any, replace the U bolt.
5. Check the buffering block and rubber lining are damaged, worn, aging, deform and etc and if there is any separation between the buffering seat and steel seat, if any, replace it.
6. Check if there is any cracking or other mechanical damage on the steel plate spring seat, lower backing plate, steel plate spring pressing plate and etc., if any, replace it.

6.4 Maintenance of the suspension assembly

6.4.1 Maintenance of the steel plate spring assembly

After long-term use, the steel plate spring may face less elasticity, steel plate cracking or breaking, wear of the lining and etc.

For steel plate spring with non-conformed arc height, it shall be replaced. In addition, as for steel plate disassembled during maintenance, magnetic powder or penetration crack detection piece by piece shall be performed. If tiredness cracking is generated, it must be replaced. When replacing the plate reed, the reed with standard length, width, thickness and arc height must be used.

For overhaul, the steel plate pin lining shall be replaced, and its matching clearance of the steel plate pin must be in line with requirements of the original manufacturer. When maintaining, if matching clearance of the steel plate pin and lining exceeds the limit, it must be replace in couple.

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appropriate amount of graphite lubrication grease is kept between the reeds. The lubrication grease is mainly used for corrosion resistance and lubrication for the second. The lubrication can not be more powerful, for friction forces between the reeds can absorb vibration. During assembling, clips of the steel plate must be provided according to specified quantity, and clearance between internal side of the clip and both sides of the steel plate spring is 0.7 ~ 1.0mm. The clip sleeve tube is about 1.0-3.0 from top of the steel plate spring to ensure that the spring can extend and contract freely. Fastening bolt on the clip of the steel plate spring can pass through from the inside to the outside, namely, the direction of the tyre to avoid damaging the tyre during travel caused by looseness of the bolts. The assembled steel plate assembly shall be closed contacted in the middle and the adjacent two pieces shall be within 1/4 of the total contact length. A small amount of clearance is allowed, no more than 1.2mm.

For assembled left and right steel plate spring assemblies, the number of reeds must be equal. The total thickness difference and arc height may not be more than the original specified rules. If there is no any rule, it shall be no more than 5mm and 10mm. besides, check side clearance of the steel plate spring and support lifting eye and the clearances on both sides shall be 0.5 ~ 1.0mm. If it is excessive, gasket is used to adjust.

6.4.2 Maintenance of the shock absorber

Main damage of the tube shock absorber is piston, working cylinder tube and etc. and failure of oil seal or seal ring gasket. When maintaining, if there is no oil leakage, experience is used to check its working performance: one iron rod passes through eye ring on both ends of the shock absorber, step on one end and the other end is pressed by hand. When it is compressed, there is resistance which becomes less; when it is extending, there is resistance which becomes more, and the working performance is sound. If conditions allow, the test can be conducted on the test bench. The contracting and extending times must be performed as per specified strength, specified efficiency and specified stroke for test and the damping force shall reach the specified values. There should be no oil leakage after placing it flatly for 24 hours. For any oil leakage found during use, the oil seal or seal ring shall be replaced. When replacing, do not damage the cutting edge. For non-conformed working performance, find out the causes; if it is caused by wear of the piston

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valve blocking or insufficient oil, clean, replace oil or add oil. The added oil quantity must be in line with the rules, more or less not allowed. If there is not absorber oil provided, No.22 turbine oil of concentration of 50% and transformer oil of concentration of 50% can be mixed together. Before adding, it shall be filtered with metallic mesh of 1200 ~ 1300meshes / cm^2. If there is no

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Chapter 7 Steering System

7.1 Sketch map of the steering system

The vehicle steering system is divided into mechanical steering system and dynamic steering system according to the steering energy.

The mechanical steering system is made up of steering operation structure, steering device, and steering transmission structure. The system takes the driver's labor force as the steering energy and all the transmission parts are mechanical transmission. The dynamic steering system is a kind of steering system employing the driver's labor force and engine power. Under normal conditions, the vehicle's steering only needs a small part of energy provided by the driver, however, in case of failure of the dynamic steering device, the driver can take the steering independently for the vehicle. Therefore, the dynamic steering system is a mechanical steering system with a dynamic device.

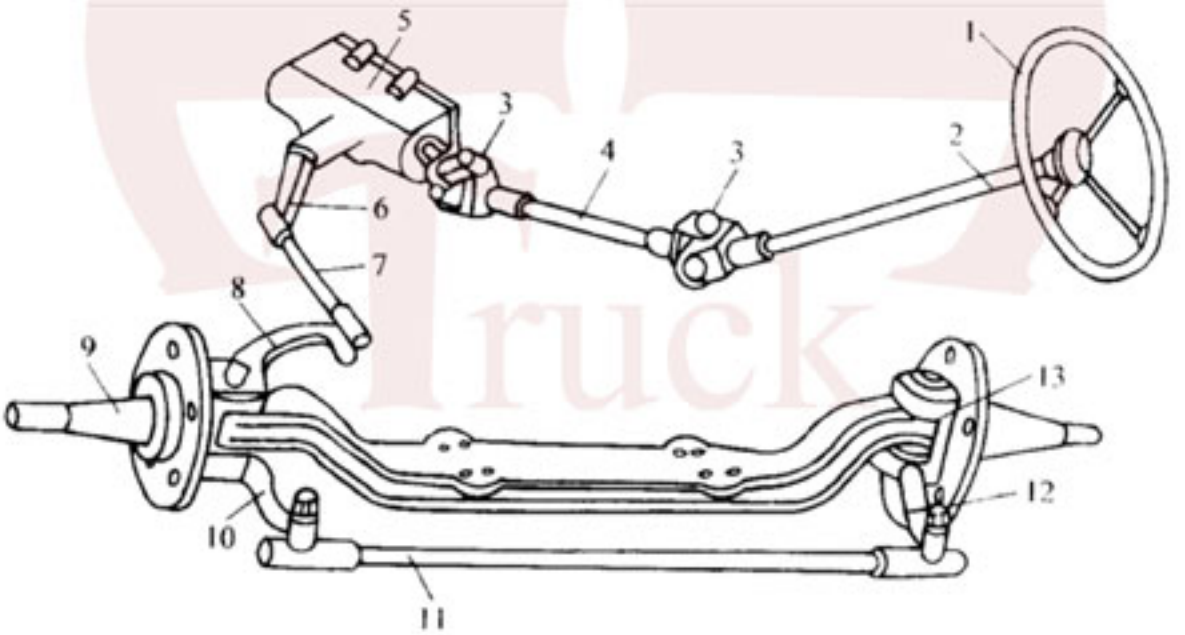


Figure 7-1 Composition of the steering system and sketch map

1-Steering disc; 2-Steering shaft; 3-Steering universal joint; 4-Steering transmission shaft; 5-Steering device; 6-Swinging arm for steering; 7-Straight pull rod for steering; 8-Steering joint arm; 9-Left steering joint; 10, 12-echelon arms; 11-Steering cross pull rod; 13-Right steering joint.

See Figure 7-1 on sketch map of the steering system. When rotating the steering disc, the steering power is transmitted to the opinion of the steering device from the steering post assembly. The opinion transmits the meshed gear rack, the direction of the power is changed and the steering

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7.2 Wear analysis of main parts

7.2.1 Operation structure

The operation structure is made up of steering disc, steering post tube, steering shaft, universal joint, steering transmission shaft and etc.

7.2.2 Steering device

The steering device is the reduction transmission device of the steering system. The cargo carrying vehicle of SC series manufactured by the company employs cycled ball steering device.

（1） Wear of the steering device

Main wear of the steering device includes: deformation and cracking of the steering device and cover, wear of the bearing and hole, wear of lining of the swinging arm shaft, damage of auxiliary working surface for meshing and etc.

（2） Maintenance of the worn parts

□Maintenance of the steering device shell, cover and hole

Cracking of the steering device can be detected by penetration crack detection. If there is any cracking, it must be replaced. If the cracking is not severe, welding can be used to repair; matching clearance of the steering device shell and bearing hole on the cover and the bearing (lining) may not be more than the original design rules 0.02mm. After wear of the hole, it can be repaired by embedding or galvanization; if lining of the steering swinging arm is worn, it shall be replaced with new ones. Interference amount for pressing of the lining is 0.05～0.08mm. The lining can be processed by boring or reaming, linings of the two holes must be co-axial. Maximum matching clearance of the lining and swinging arm shaft may not be more than the original design rule 0.005mm; planarity error of the whole combined surface of the steering device shell and cap shall be no more than 0.1mm. Otherwise, it shall be grinded.

□Maintenance of the transmission couple

Rolling channel from the steering device to the nut shall be no metal scale, the rolling ball specifications and quantity shall be in line with the original design rules, with diameter difference no more than 0.01mm. Matching clearance of the ball and rolling channel can be inspected by

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0.05mm; hang the screw vertically, if the ball nut falls down stably under the gravity, it is normal. If it falls fast or blocks or the matching clearance exceeds the rules, it shall be replaced in couple and steel ball with larger size can be used.

7.2.3 Steering transmission unit

(1) Steering joint

Main wear of the steering joint includes: cracking at root of the finger shaft, wear of the main pin hole, wear of the shaft neck of the wheel hub bearing, damage of the end screws, wear of the upper and lower end surfaces of the main pin hole, change of angle between the main pin hole axis and root shaft axis and etc.

Inspection and repair of the steering joint:

□ Cracking at the root of the finger shaft can be inspected by penetration or magnetic power crack detection. In case of crack at the root of the finger shaft, it shall be replaced with new ones.

□ Matching clearance of main pin of the steering joint and lining shall be in line with the original rules, if it exceeds the rules, the lining shall be replaced. Processing of the lining shall employ reaming, boring or broaching. When reaming is used, long-edge reaming knife or the guide rod is used to ream two holes one time to ensure co-axial degree of the upper and lower holes. When lining is embedded, oil hole of the lining shall aim at oil nozzle of the steering joint. Matching clearance of the steering joint main pin and lining is 0.02～0.09mm and the limit is 0.15～0.20mm.

□ If matching of the internal and external bearing of the steering joint and shaft neck is clearance matching, it shall be in line with original rules; if it is transitional matching, when the basic size is no more than 40mm, the maximum clearance shall be no more than 0.04mm; when it exceeds 40mm, the clearance shall be no more than 0.05mm. After wear of the shaft neck, it can be repaired with galvanization or coating. Matching clearance of the wheel hub bearing and shaft neck is about 0.10mm.

□ Screw damage at the end may not exceed 2 teeth, otherwise, the screw shall be removed; after surfacing welding, the screw is additionally formed.

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□ Angle of public axis of shaft neck of the steering joint and main pin hole shall be in line with original rules, otherwise, it will be rejected.

(2) Steering swinging arm

There should be no cracking on the steering swinging arm and obvious torsion on the spline. End surface of the spline hole of the steering swinging arm shall be 2-5mm higher than that of the swinging arm shaft. If there is crack on the swinging arm or the spline shaft aligned with the hole end surface caused by wear, the steering swinging arm shall be replaced.

(3) Steering joint arm

There should be no crack on the steering joint arm. When the cone pin neck matches the cone hole on the steering joint, the small end surface of the cone pin neck shall be 1-2mm into the cone hole. Spline and spline channel of the cone pin shall match closely.

(4) Cross and straight pull rods

There should be crack and other damage on the cross and straight pull rods. There should be obvious deformation on the straight pull rod. Linear error of the cross pull rod shall be no more than 2mm, deformation of both ends of the arc cross pull rod at the front drive may not be more than 1.5mm, if it exceeds, cold pressing is used to calibrate. Depth of clip spring on the joint of the cross pull rod can not lower than 1/2 of width of the clip spring. When wear of hole of the ball joint of the straight pull rod is extended to 2mm, surfacing welding can be used to make it to standard size, or weld one piece no less than 3.5mm thick with standard size hole on it. If screw on the end of the straight pull rod is damaged, it can be repaired by re-tapping. If upper flange of joint seat hole of the cross pull rod is worn, when the thickness is less than 2mm, turning repair can be used after surfacing welding.

When wear of single side of the sphere of the ball joint pin exceeds 1mm, it shall be replaced with new ones or repaired. If the wear is excessive, the spring is failure or the faucet is damaged, it shall be replaced.

7.3 Disassembly of the steering system

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(1) Disassemble negative wire of the accumulator, and dismount upper cover for steering;

(2) Screw off lock nut of the steering disc;

(3) The steering disc and steering shaft are marked for alignment when reassembling;

(4) Special tools are used to dismount the steering disc;

(5) Dismount the upper cover and lower cover of the steering post;

(6) Dismount plugs of the combined switch and ignition switch bundle, screw off fixing screws of the combined switch to take it off;

(7) Dismount joint bolt of the lower shaft of steering device;

(8) Screw off assembly bolt of the steering post, and take the steering post assembly off.

7.3.2 Disassembly of the steering pull rod and steering device

(1) Lift up the vehicle, disassemble the wheel and screw off the opening pin and channel nut of end of the steering cross pull rod from the steering joint;

(2) Special disassemble device is used to take end of the steering cross pull rod from the steering joint;

(3) The assemble mark is done on location of the locking nut of the steering cross pull rod end and screw of the steering cross pull rod to disassemble the cross pull rod assembly;

(4) Dismount the opening pin, steering straight pull rod channel nut and bolt;

(5) Dismount the joint bolt of the lower end of the steering shaft;

(6) Dismount assembly bolt of the steering device shell, then take the steering device off;

7.4 Assembly of the steering system

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there will be no details given.

When installing the steering device, pay attention to the following:

(1) Check oil quantity of gear of the steering device to make oil quantity of the steering device in line with the standard;

(2) Make the steering device to the limit location to one direction, then return it half to ensure it stays in the middle of the total travel;

(3) Tighten installation bolt of the steering device to make it conformed;

(4) Calcium base lubrication grease is added in the ball head pin.

7.5 Failure and experience analysis

Steering shaft of most vehicles is front shaft. Common failure of the front shaft and transmission system is abnormal wear of the front wheel tyre, big free travel of the steering disc, heavy steering, automatic deviation, swinging of the front wheel and etc.

7.5.1 Abnormal wear of the front wheel tyre

(1) Failure: the tyre wear is accelerating, and abnormality on the tyre.

(2) Causes:

1) The tyre pressure is not conformed;

2) The tyre is not exchanged for position for a long time;

3) Incorrect locating of the front wheel, especially matching of the toe-in and camber;

4) Looseness of the wheel hub bearing or steering joint and main pin;

5) Looseness of the longitudinal and cross pull bar or steering device;

6) Looseness of U bolt of the steel plate spring;

7) Looseness of the steel plate spring lining and the pin;

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9) Rotating quality of the front tyre is not balanced;

10) Swinging head of the front tyre;

11) Non-verticality of the front shaft and longitudinal center line of the frame or unequal wheelbase at both sides of the frame;

12) Bending and torsion of the front shaft or frame;

13) Low toughness of the front shaft;

14) Low toughness of the steering cross pull rod (especially the arc cross pull rod) or cross pull rod arm;

15) Slow brake reset or lagging brake;

16) Looseness of the tyre bolt;

17) Frequent overloading, deflected loading, fast starting, turning at high speed or fast brake;

18) Traveling on road of big surround frequently;

19) The steering echelon can not ensure pure rolling of the wheels, excessive turning or inadequate turning;

20) Poor tyre quality.

(3) Diagnosis method: see the Figure 7-2 on sketch map of abnormal wear of the front tyre. See Figure 7-3 on the flow chart for diagnosis.

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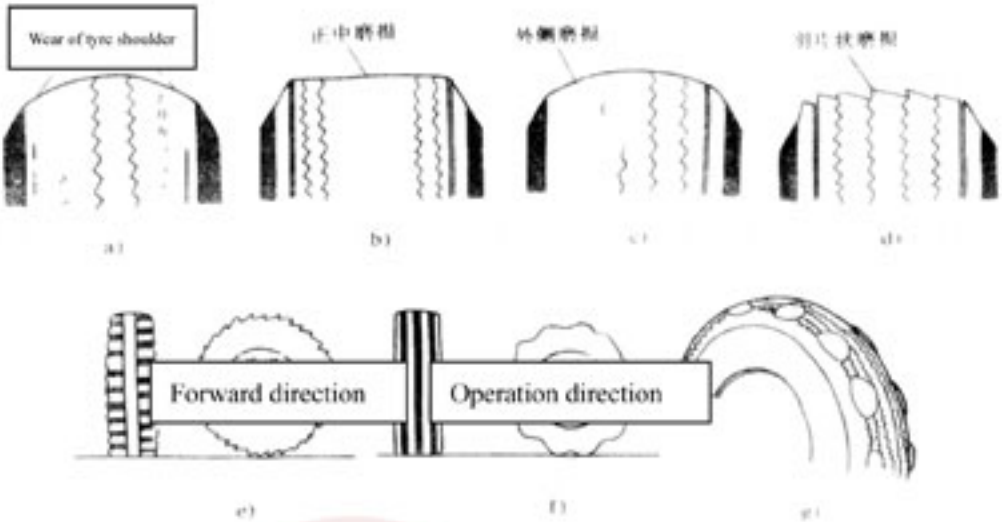
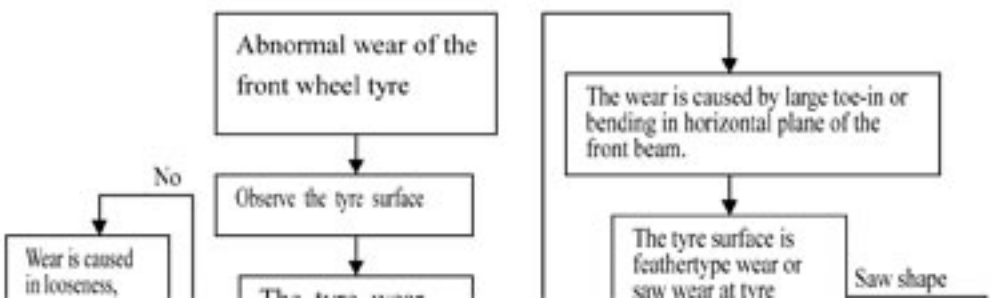


Figure 7-2 Sketch map of abnormal wear of the front tyre

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Figure 7-3 Flow chart for diagnosis of abnormal wear of the front tyre

7.5.2 Big free travel of the steering disc

(1) Failure: when the vehicle keeps still when keeping the linear travel position, rotate the steering disc, the walking angle is big.

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1) Looseness of driving and driven meshing parts of the steering device or bearing of the driving and driven parts;

2) Looseness of connection of the steering disc and steering shaft;

3) Looseness of connection of vertical arm shaft and vertical arm of the steering device;

4) Looseness of connection of the longitudinal and cross pull rod ball head;

5) Looseness of connection of the longitudinal and cross pull rod arms and steering joint;

6) Looseness of universal joint and main pin;

7) Looseness of the wheel hub bearing.

(3) Diagnosis method: it is required according to the flow chart 7-4.

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Figure 7-4 Flow chart for big free travel of steering

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(1) Failure: during travel, when the driver rotate the steering wheel leftwards or rightwards, he feels heavy; when the vehicle turns at low speed or changes the direction, it is hard to rotate the steering wheel even can not work.

(2) Causes:

1) Insufficient tyre pressure;

2) Matching of the steering joint and the main pin is too tightened or lacking oil;

3) Connection of the cross and longitudinal pull rod ball head or lacking in oil;

4) Pre-tightening force of bearing of the driving part of the steering device is too large or matching of the driven part and lining is too tightened;

5) Meshing of driving and driven parts of the steering device is too tightened;

6) There is no oil or not sufficient oil in the steering device;

7) Thrust bearing of the steering joint lacks oil or is damaged;

8) Bending of steering shaft of the steering device or collision by concavity;

9) Excessive back inclination of the main pin, kingpin of the main pin or negative camber of the front wheel;

10) Deformation of front beam and frame causes incorrect locating;

(3) Diagnosis method: it is performed according to the following method. See 7-5 on the flow chart.

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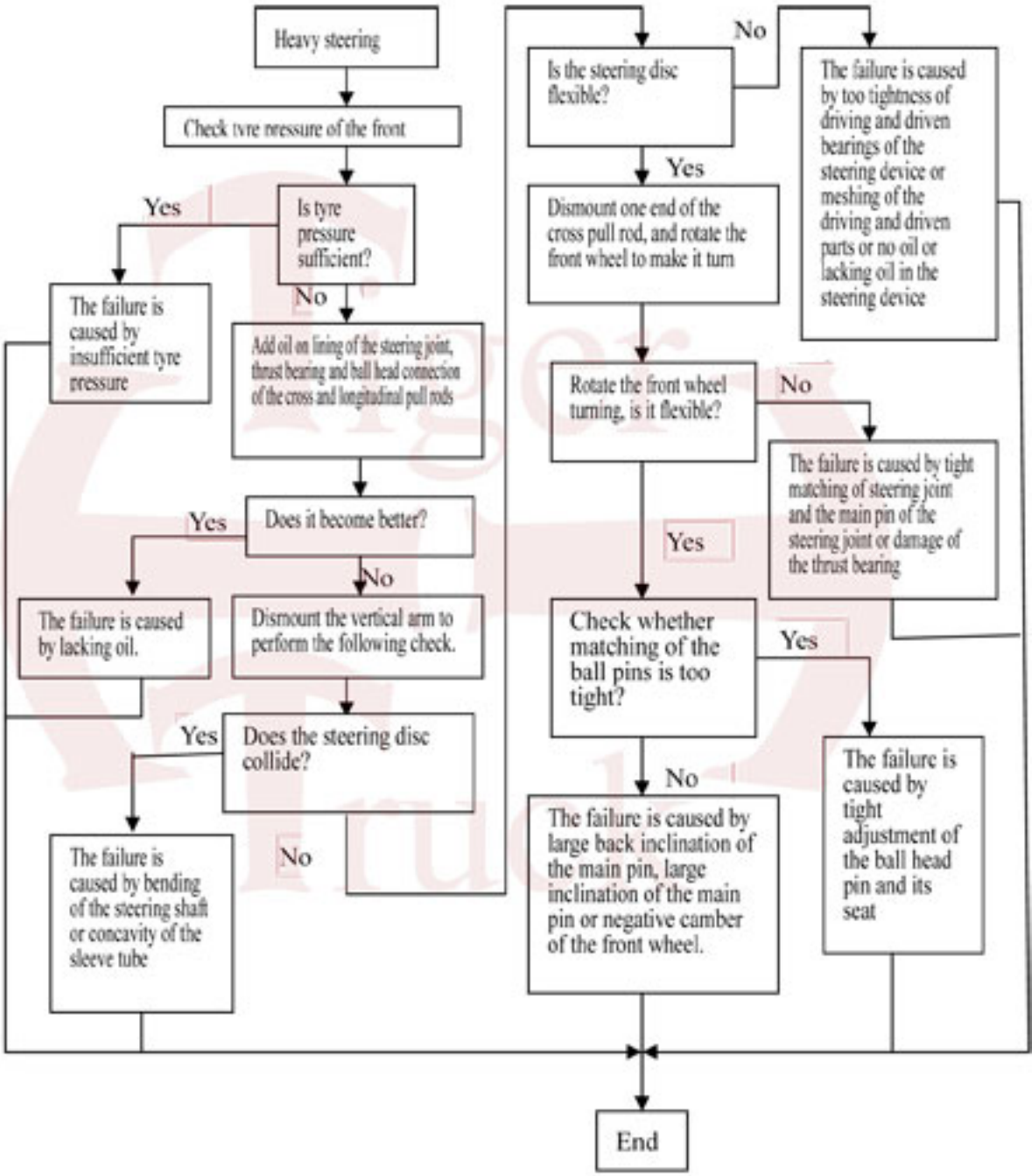


Figure 7-5 Flow chart for heavy steering

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(1) Failure: during travel, the vehicle runs to the other side automatically, holding the steering wheel can keep straight line running.

(2) Causes:

1) Uneven tyre pressure or inconsistent diameter of the front two wheels or uneven loading;

2) Unequal spring flexibility or uneven spring of the left and right steel plate;

3) Bending in the shaft tube of the front beam or rear axle or bending in the horizontal plane of the frame;

4) Unequal wheel base at both sides of the vehicle;

5) Inconsistent tightness of the wheel hub bearing or oil seal of the front two wheels;

6) Single brake or single lag for wheel with front and back axles;

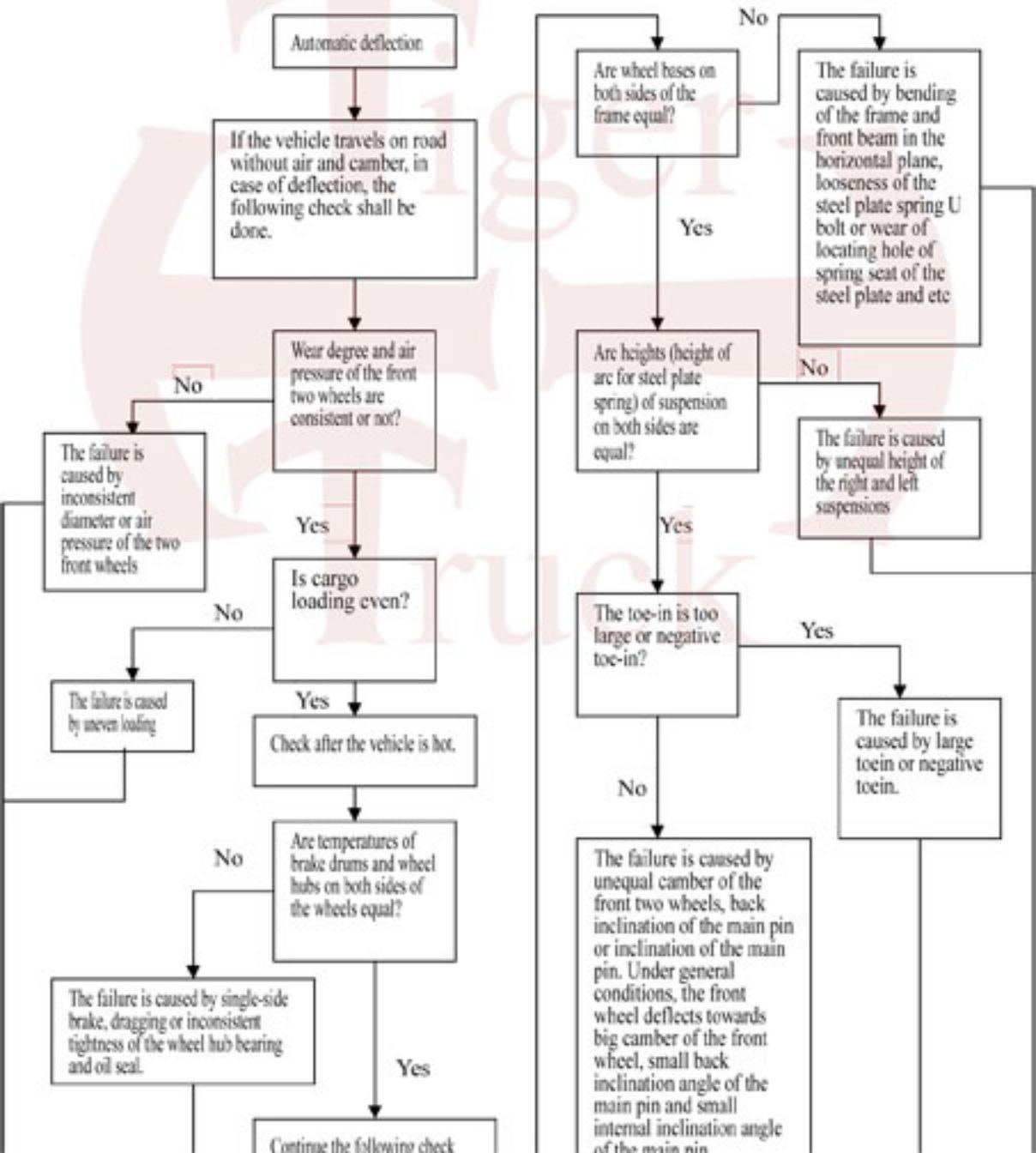
7) Unequal camber of the front two wheels, back inclination angle of the main pin or internal inclination of the main pin;

8) Large toe-in or negative toe-in;

9) Large arching factor of the road surface or with side wind.

(3) Diagnosis: it is conducted according to the following method. See the flow chart 7-6.

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Figure 7-6 Flow chart for diagnosis of automatic deflection

7.5.5 Swinging head of the front wheel

(1) Failure: when the vehicle travels at low speed or high speed, the front two wheel may rotate with its main pin for angle vibration, called swinging head of the front wheel. Especially at high speed, the front wheels swings severely, the hand feels numb and the head is swinging seen from the cab.

(2) Causes:

1) Unbalance of rotating mass of the front wheel (including tyre, wheel rib, brake drum or disc, wheel hub and etc.);

2) Large jump of radial circle of the front wheel or end surface circle;

3) Renewed tyre is used for the front wheel;

4) Small camber of the front wheel, large toe-in, negative back inclination of the main pin or large back inclination of the main pin;

5) Inconsistent back inclination angle or internal inclination angel of main pin of the front two wheels;

6) Bending or deformation of the front beam or frame;

7) Interference f the steering system and front suspension;

8) Low toughness of the steering system (such as cross pull rod, cross pull rod arm,

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9) Large meshing clearance or bearing clearance of the driving and driven part of the steering machine;

10) Matching looseness of vertical arm of the steering machine and its shaft;

11) Looseness of connection of ball head of the longitudinal and cross pull rods;

12) Looseness of the steering joint and main pin or matching of steering joint and fist part of the front beam along axis of the main pin;

13) Looseness of bearing of front wheel hub;

14) Looseness of connection on the frame of the steering machine;

15) Failure of shock absorber of the front suspension or inconsistent shock absorption performance of the left and right absorber;

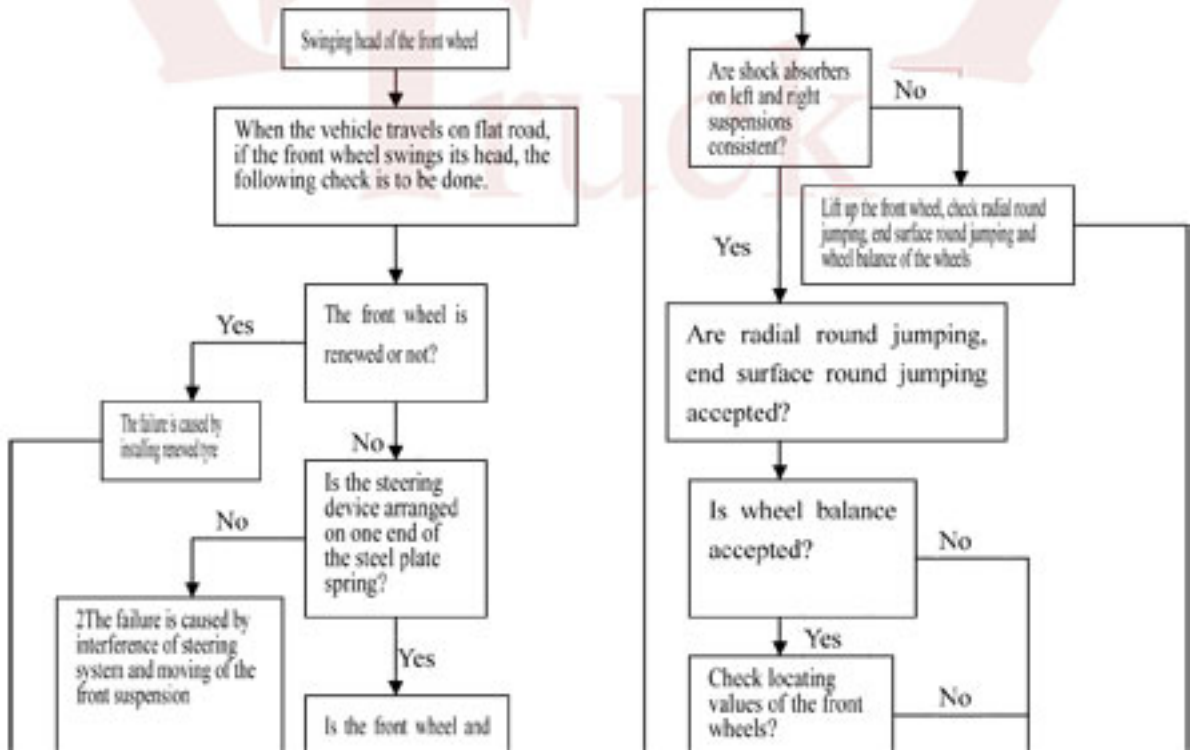
16) Inconsistent height or toughness of the left and right suspensions (thickness, length, number of piece, arc height or new and old degree for steel plate spring);

17) Looseness of U bolt of the front steel plate spring or matching of the steel plate pin and the lining;

18) Large unevenness of the road, the impact frequency of road the wheel is consistent with inherent frequency of angle vibration of the front beam, affected by gyroscope effect, the front wheel swings.

(3) Diagnosis: it shall be performed according to the following methods. See the flow chart7-7 for detail.

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Figure 7-7 Flow chart for swinging of the front tyre

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Chapter 8 Braking System

8.1 Layout diagram and structure of braking system

8.1.1 Layout diagram of braking system

Braking system of Changan Automobile includes two systems of service brake and parking brake. Refer to the layout diagram (Fig. 8-1).

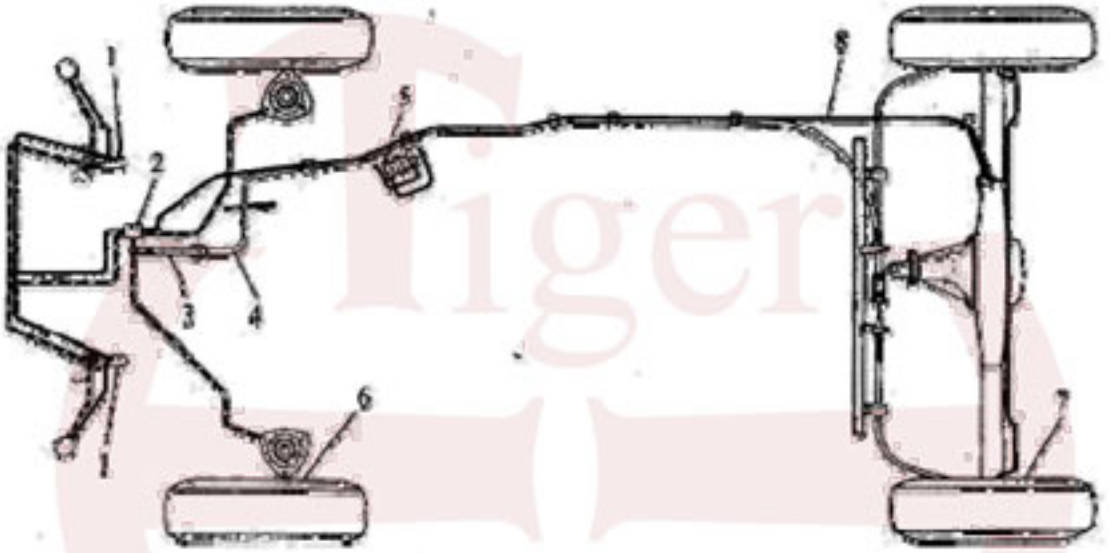


Fig. 8 - 1 Layout diagram of braking system

1- brake chief pump ; 2- five-way valves ; 3- parking brake handle ; 4- parking brake cable ; 5- proportioning valve ; 6- front wheel brake ; 7- rear wheel brake ; 8- oil pipe

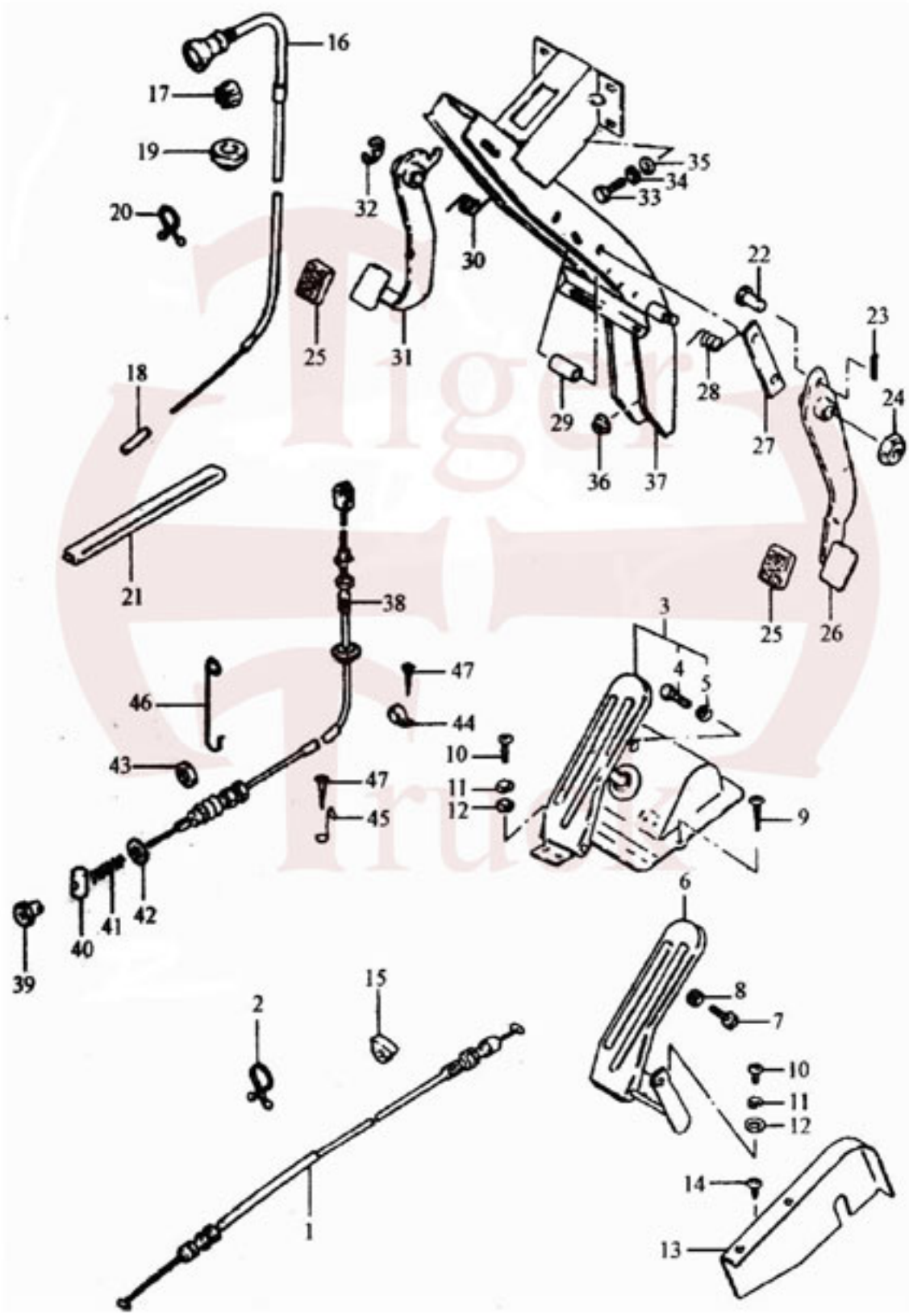
Service brake is dual circuit hydraulic brake system, and uses H-shape circuit, which means that one brake circuit is used for two front wheels and another brake circuit is used for two rear wheels. Working medium of these two brake circuits is mutually independent, when one brake circuit can't be run, another brake circuit can still retain the certain braking energy to improve the safety of vehicle driving. For brake circuit of rear wheel, can choose proportioning valve, so that braking force of rear wheel brake can be distributed at the ideal proportion, and favorable to improve directional stability when the wheel is braking. Parking brake is mechanical flexible shaft drive, and rear wheel brake is concurrently worked as parking brake.

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8.1.2 Structure of brake device

1 . Structure of brake pedal

For structural components of brake pedal, see Fig. 8-2:



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1- accel pedal cable ; 2-clip ; 3- accel pedal assembly ; 4-bolt ; 5-nut ; 6- accel pedal ; 7-bolt ; 8-nut ; 9-bolt ; 10-bolt ; 11- lock washer ; 12- washer ; 13-cable cover ; 14-bolt ; 15- sealing ; 16- throttle cable ; 17-nut ; 18-shield ; 19-sealing ; 20-clip ; 21-protection device of cable ; 22-pin ; 23-Opeing pin ; 24-nut ; 25- pedal pad ; 26-brake pedal ;27- pedal axial plate ;28- spring of brake pedal ;29- spacer ;30- pedal spring of clutch ;31- clutch pedal ; 32-E-shape ring ; 33-bolt ; 34-lock washer ; 35-washer ; 36-nut ; 37-bracket ; 38- clutch cable ; 39-nut ; 40-pin ; 41-spring ; 42-washer ; 43- cushion ; 44-clip ; 45-clip ; 46-clip ; 47-bolt

2 . Structural components of brake chief pump and brake circuit

(1) Brake chief pump

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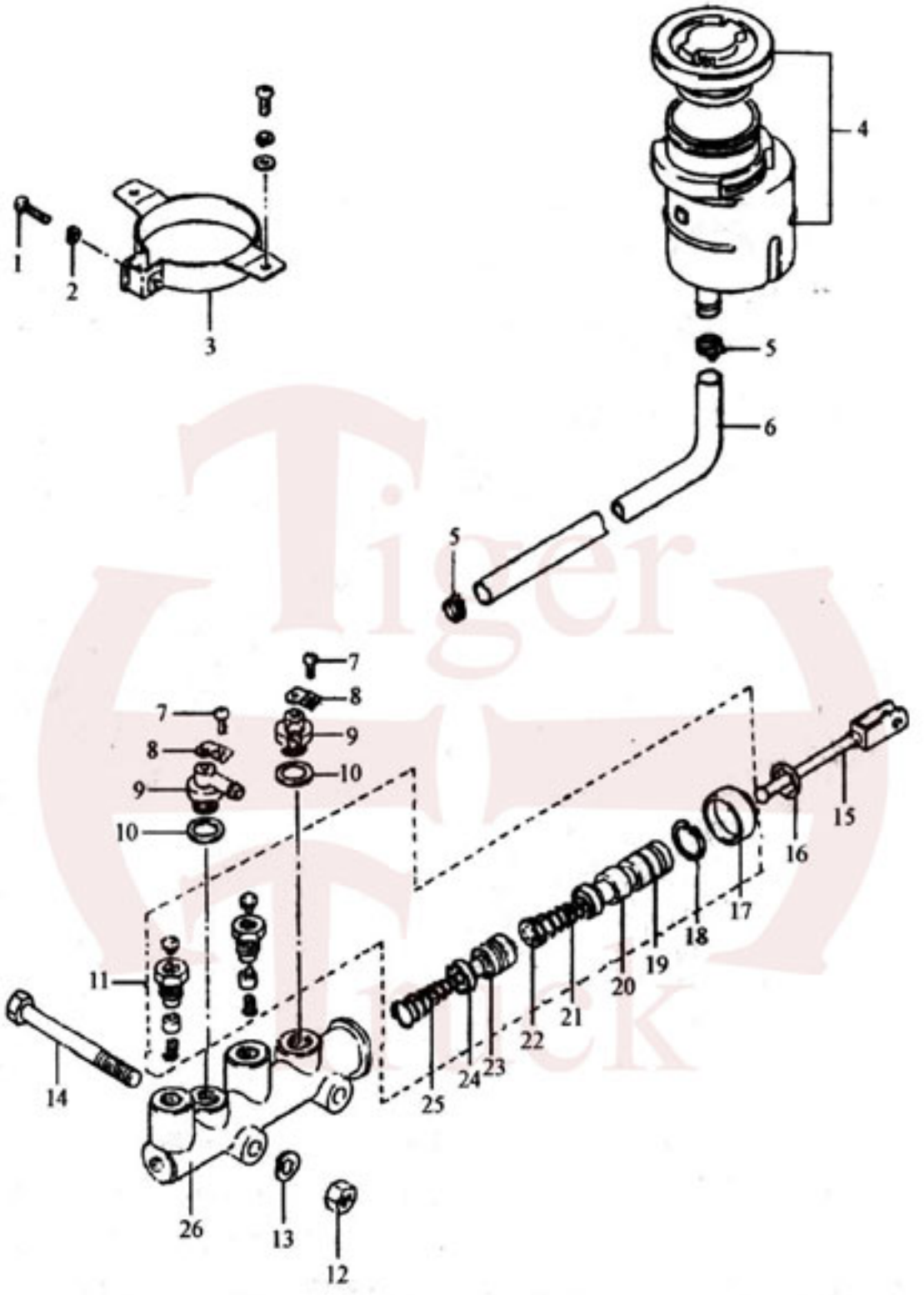


Fig. 8 - 3 Structural components of brake chief pump

1-bolt ; 2- lock washer ; 3- holt hoop iron ; 4-fluid reservoir ; 5- holt hoop iron ; 6-hose ; 7-bolt ; 8-clip ;

9- inlet connector ; 10-O-shape ring ; 11- outlet connector ; 12-nut ; 13- lock washer ; 14-bolt ; 15-push rod ; 16-

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24-cup ; 25- return spring ; 26-chief pump shell

(2) Vacuum booster

Vacuum booster is located in the middle of brake chief pump and brake pedal, and adopts the engine vacuum to mechanically increase the force caused by brake pedal when it is stepped for the purpose of braking save labor. For structural components of vacuum booster, see Fig. 8-4.

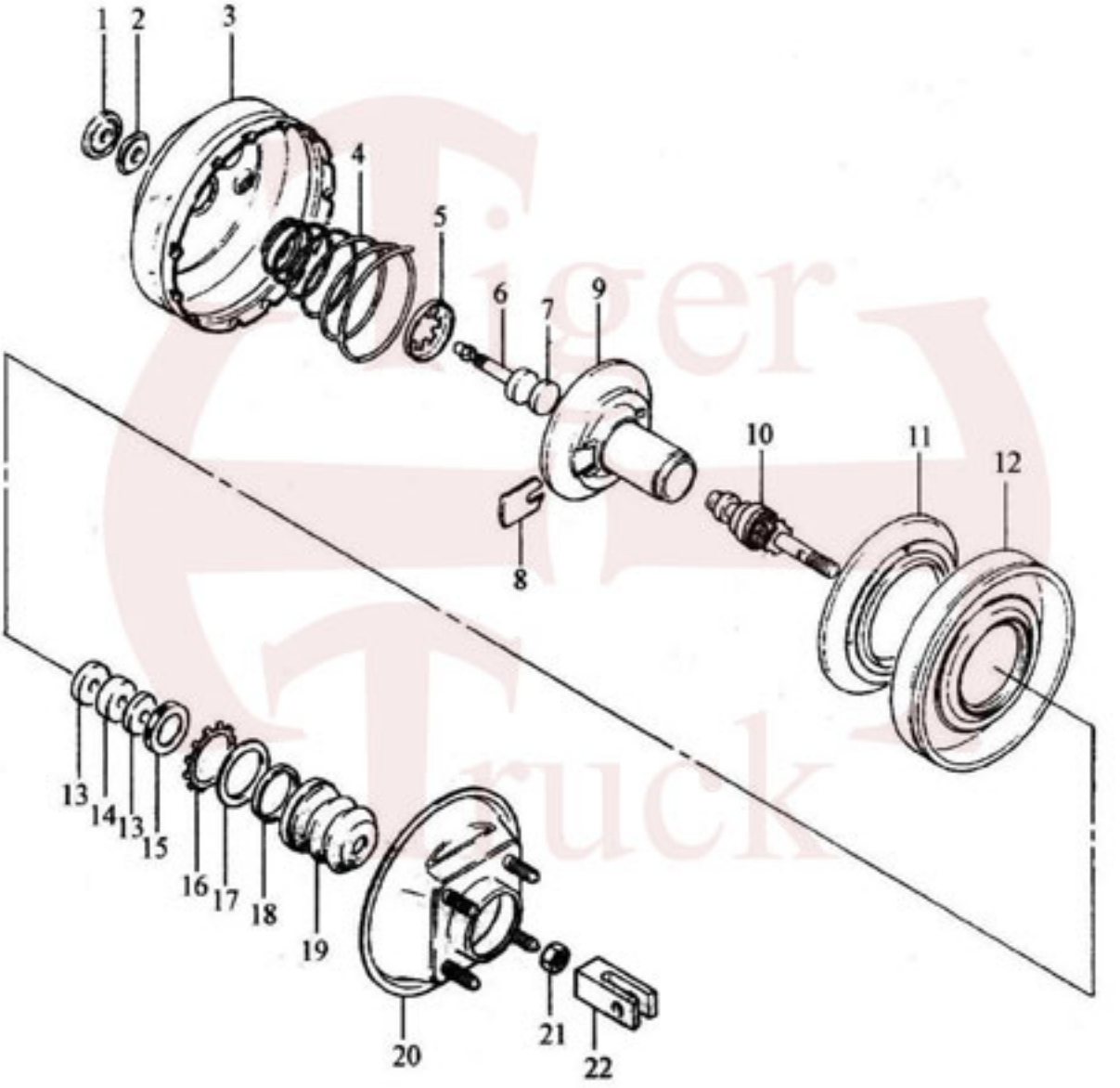


Fig. 8 - 4 Structural components of vacuum booster

1-front gas seal ; 2-front gas seal plate ; 3- shell of 1# booster ; 4- return spring of booster piston ; 5- return ring of piston rod ; 6- piston rod ; 7- reaction disc ; 8- valve guard 0 ; 9- booster piston ; 10- booster valve assembly ;

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17- piston pivot ring ; 18- gas seal of 2# shell ; 19- booster shield ; 20- 2# shell of booster ; 21-nut ; 22- clevis pin of push rod

(3) Brake piping

For structural components of brake piping, see Fig. 8-5:

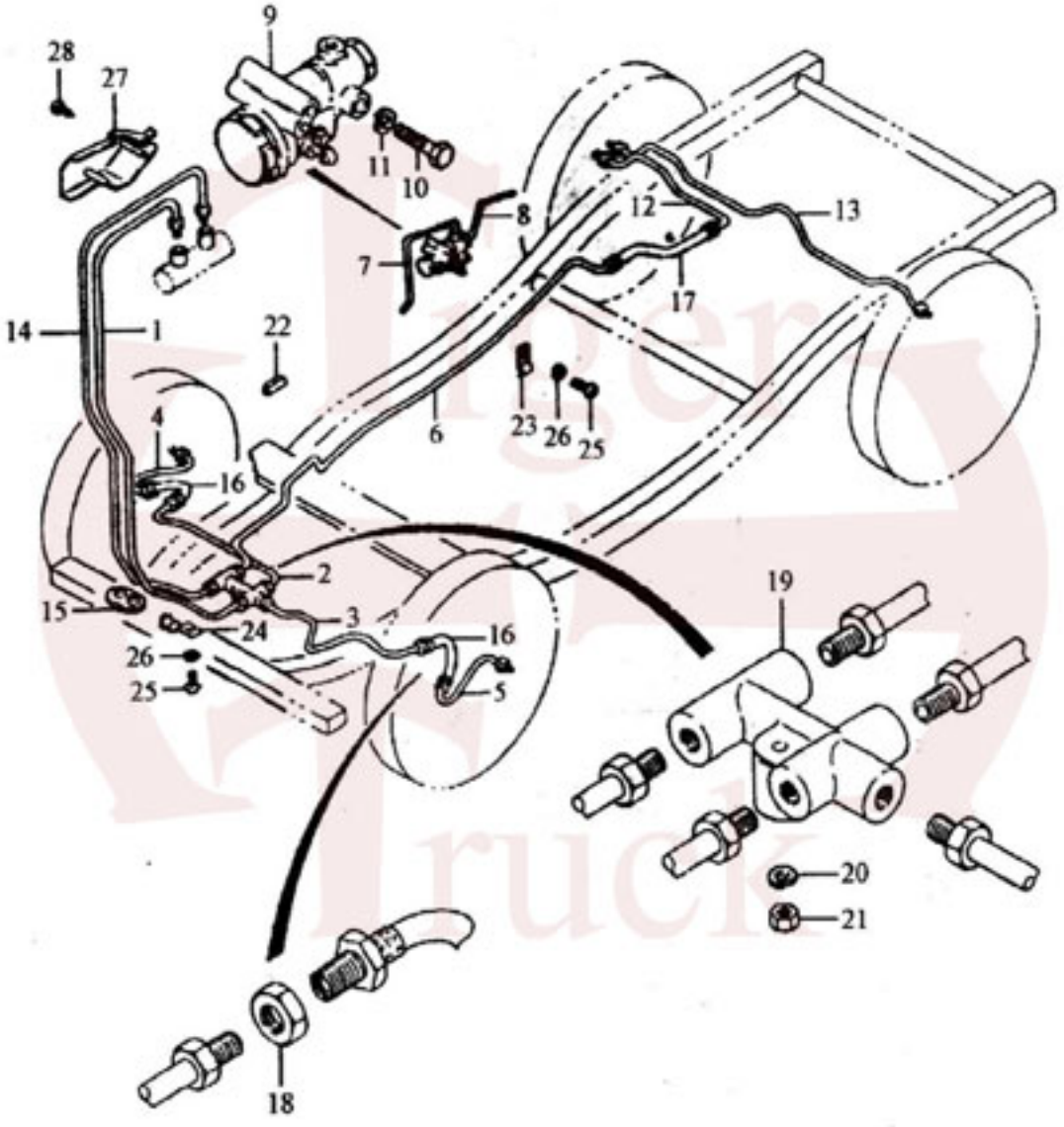


Fig. 8 - 5 Structural components of brake piping

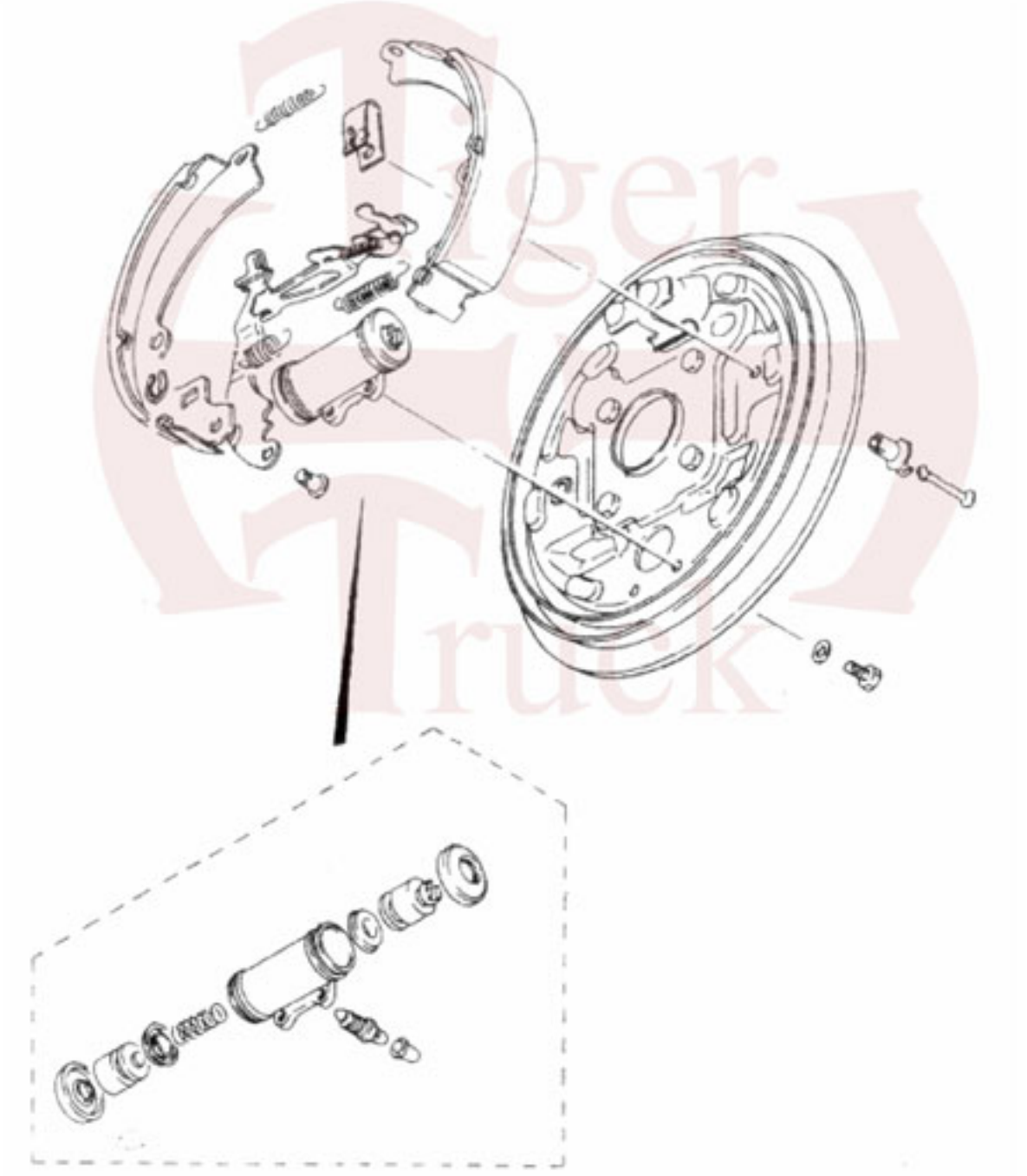
1- brake chief pump to five-way valve tubing (front) ;2- five-way valve to front braking tubing (right) ;3- five-way valve to front braking tubing (left) ; 4- front brake lock tubing (right) ; 5- front brake lock tubing (left) ; 6- five-way valve to rear braking tubing ; 7- proportioning valve inlet tube (optional) ; 8- proportioning valve

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hose ; 13- rear brake tubing ; 14- chief pump to five-way valve tubing (rear) ; 15- rubber gasket ; 16- front brake hose ; 17-rear brake hose ; 18-nut ; 19- five-way valve ; 20-washer ; 21-nut ; 22-shield ; 23-clip ; 24-clip ; 25-bolt ; 26-washer ; 27-chief pump cover ; 28-bolt

3 . Structure of wheel brake

Front and rear wheel brake of SC series truck of Changan uses leading trailing shoe brake, and the structure can refer to Fig. 8-6:



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4 . Structure of parking brake device

For structural components of parking brake device, see Fig. 8-4.

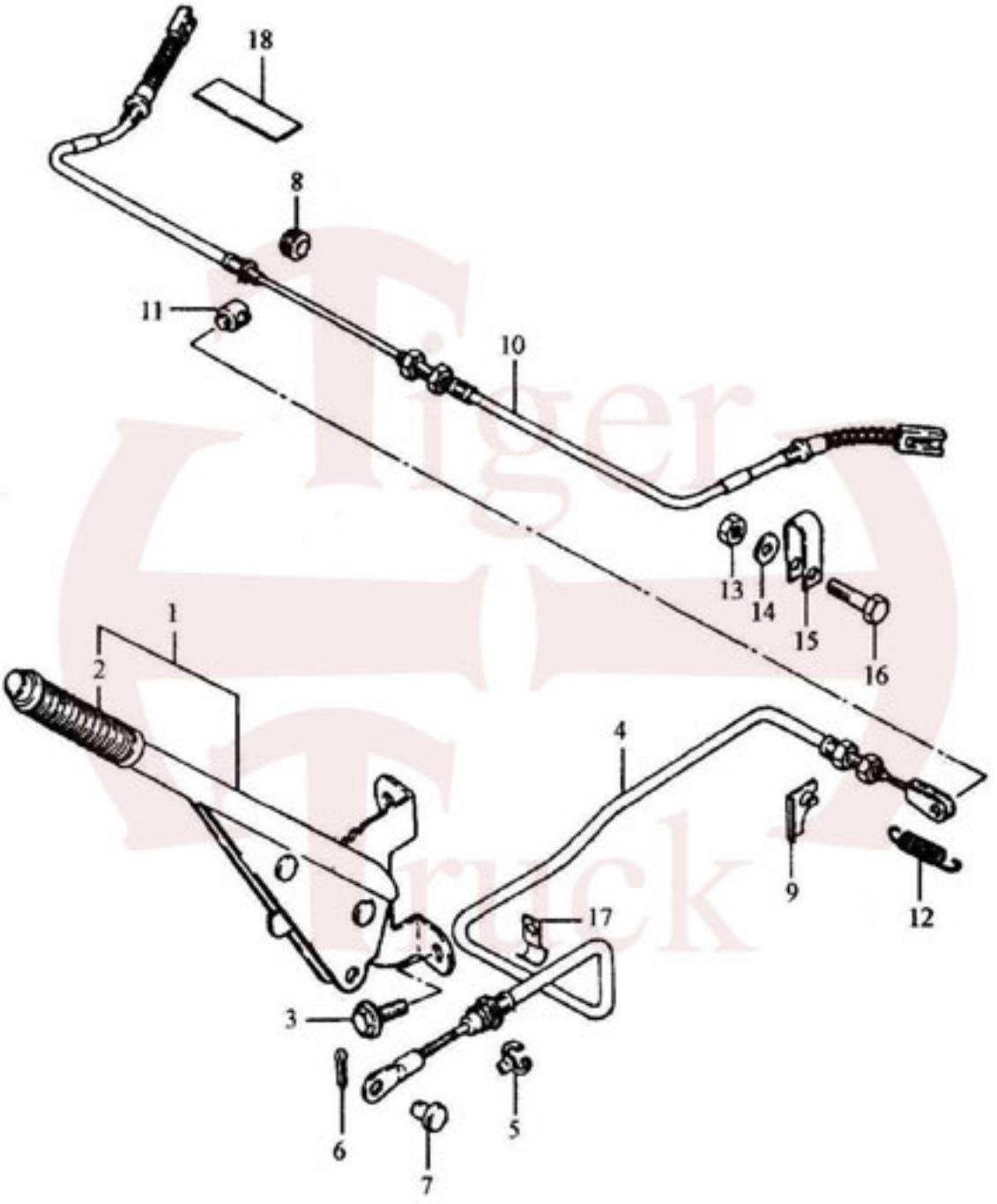


Fig. 8 - 7 Structural components of parking brake device

1- joystick ;2-handle ;3-bolt ;4-cable ;5-E-shape ring ;6- split pin ;7-pin ;8- rubber ring ;9- baffle plate ;10-cable ;

11-pin ; 12-spring ; 13-nut ; 14-washer ; 15- bending plate ; 16-bolt ; 17-clip ; 18-plate

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8.2 Analysis of main component wear

The performance of auto brake mainly depends on the braking torque produced by brake friction pairs and the road adhesive conditions required by wheel. Therefore, mail component wear of the wheel brake is below:

8.2.1 Wear analysis of friction lining

Friction lining is the main component produces braking force, therefore, friction lining wear becomes the main reason that affects brake performance, and then main performance parameter of friction lining - friction coefficient, becomes main parameter affects brake performance. So, the change of friction coefficient becomes the leading factor of friction lining wear.

Followings are main reasons affects the friction coefficient:

(1) Lining material

Lining material is the main factor affects friction coefficient. When friction lining is changed, should choose the lining recommended by the manufacturer to guarantee braking performance of the original auto. Meanwhile, should notice that all brakes of the same auto must use the material of the same brand, which is the important factor to make sure brake balance coordination of each wheel.

(2) Working temperature of friction lining and brake drum

When working temperature of the brake is too high, friction lining can lead to heat fade and make friction coefficient reduced obviously. Lining heat fade means material polymers of lining will decompose to some gases and liquids at the high temperature, and gases and liquids will be acted as the lubrication among friction surfaces to reduce friction coefficient and deteriorate braking performance.

When the brake is maintained, many factors will destroy heat dissipation conditions of the brake to make working temperature of the brake higher. Thereinto, conjoint status of friction lining and horseshoe is the key factor affects lining heat dissipation. If there is foreign body or spacing, heat dissipation efficiency of the lining will be reduced. So, when the lining is re-riveted, must ensure the joint surfaces is flat and clean and must be riveted, and forbid adding the gasket between them to adjust the radius of curvature of brake shoe. Otherwise, if it is too long, friction lining can lead

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between shoe and drum during normal driving, so that working temperature of the brake can be increased.

(3) Surface quality of friction lining

Surface oil pollution and ablation of friction lining can make friction coefficient reduce.

8.2.2 Brake analysis of shoe and drum

(1) Form and position error of brake shoe and brake drum

Brake shoe and brake drum have round and taper and can cause the connivent area of shoe and drum to reduce and decrease the braking performance. Otherwise, when the phenomena of ellipse or the different axle is existed, the contact of shoe and drum is unstable during braking and can create the vibration and impact to make hydraulic braking performance reduce.

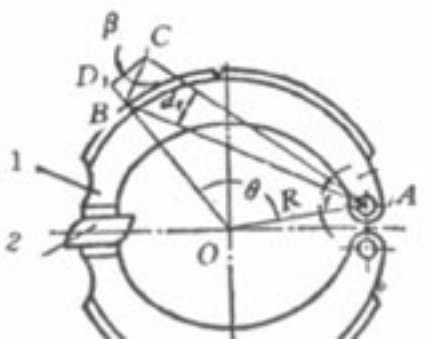
(2) Rigidity of brake drum

The rigidity of brake drum is deficient, and can produce the bigger deformation during braking to decrease pressed force of shoe and drum, so that braking performance will be reduced. Main factors affect the rigidity of brake drum include working temperature and wall thickness of brake drum. If working temperature is too high and wall thickness is reduced, both of them can reduce the rigidity. So, should control the inner diameter in the permissible range in the course of repairing to make sure that wall thickness of braking drum meets the standard.

(3) Surface roughness of brake shoe and brake drum

Too high surface roughness of brake shoe and brake drum will make actual contact area small, and if the load is concentrated on the emboss, it will make the contact temperature too high to be ablated, so as to reduce braking performance and accelerate the part damage. Currently, processing methods of brake shoe include the boring and the grinding. The grinded brake shoe has the lower surface roughness but braking performance is better.

(4) Clearance between shoe and drum



The clearance between shoe and drum is too small, and they can't be completely separated, not only create braking error, but also make the brake temperature too high to reduce braking performance; If the clearance is

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too big, it will make the braking force reduce, even can't be braked. Therefore, when the brake is maintained, the brake clearance must be carefully checked and adjusted to meet the standard, and the clearance of left and right wheel of the same axle must be consistent.

Fig. 8 - 8 Displacement when brake shoe is opened

1 - brake shoe ; 2 - brake camshaft

(5) Anastomosis of brake shoe and brake drum

If other conditions are the same, the anastomosis of brake shoe and brake drum has great effect on braking performance.

Anastomosis of shoe and drum includes three instances: synchronously comprehensive anastomosis of shoe and drum, anastomosis of the middle of shoe and drum, and anastomosis of two ends of shoe and drum.

1) Synchronously comprehensive anastomosis of shoe and drum

When the shoe is opened, shoe and drum will be anastomosed completely at the same time, friction area is large and load distribution is uniform; the deformation of shoe and drum is small, working temperature is low, the change of friction coefficient is small but braking performance is good. It is difficult to realize, even impossible to come true because of following reasons.

□ Open speed (radial displacement) of each point on the shoe is different. According to Fig. 8-8, when brake shoe of simple non-balance brake is opened, radial displacement of each point on the shoe is introduced as follows:

Choose randomly point B on the brake shoe, when brake shoe turns to the angle of dr around pinhole center A, point B will move to point C and the displacement is BC. Displacement BC is decomposed to radial displacement BD and tangential displacement DC. Radial displacement BD is the efficient displacement to cancel the clearance between shoe and drum. According to the figure, for it is small, dr can be regarded as □CBA≈90°

therefore: $BD=BC\cdot\sin\beta$ $BC\approx AB\cdot dr$

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According to sine theorem: $AB=\frac{R \bullet \sin\theta}{\sin\beta}$ (8 - 2)

formula (8 — 1) will be replaced by formula (8 — 2) , so

$$BD\approx R \bullet \sin\theta\, dr \qquad (8-3)$$

According to formula (8 — 3), when θ is 90° (the middle of frictional plate of brake shoe), radial displacement of friction lining of the shoe is largest and gradually reduces to two ends. When θ is 0° and 180°, radial displacement becomes zero.

For Fig. 14-2, it is radial displacement of each point on the frictional plate when brake shoe of certain auto brake conquers clearance opening 18' between shoe and drum. From this figure, radial displacement of frictional plate middle is larger 60% than two ends.

Otherwise, for different opening value-dr, its difference is changed. For brake drum creates min. deformation and the braking force is not the same during braking, it is different between actual displacement and theoretic displacement. It is obvious that the shape and the size of brake shoe are taken measures, so that it is almost impossible to synchronously cancel the clearance between each point and brake drum during the shoe is opened to realize synchronously comprehensive anastomosis.

② Brake shoe and brake drum have processing error. Only curvature radius of shoe and drum is the completely same, and then maybe realize synchronously comprehensive anastomosis. But, there is the error of size, shape and orientation while processing, and add the influence of equipment precision, it is difficult to make sure curvature radius of them is the same.

③ Assembly and adjustment have errors. During assembly, wheel brake can create the deformation of brake carrier, knuckle spindle deformation or axle tube deformation, wrong mounting position of brake carrier or hub bearing; When adjusting, the clearance between shoe and drum is adjusted improperly to cause relative position error of shoe and drum. It is difficult to make brake shoe and brake drum comprehensive anastomosis in the course of the shoe opening.

2) Anastomosis of the middle of shoe and drum

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is not less than two-end clearance. When the shoe is opened, the shoe middle will first contact with brake drum (Fig. 8-9) because of the big displacement of the shoe middle. So, there is only one contact for each shoe and brake drum, and the pressure of two shoes has been concentrated on two points of the drum. The stress is 10 times bigger than comprehensive anastomosis, and the deformation of brake drum is big, and the abrasion of the lining middle is strengthened which is easy to create the scorch and obviously reduce the braking performance.

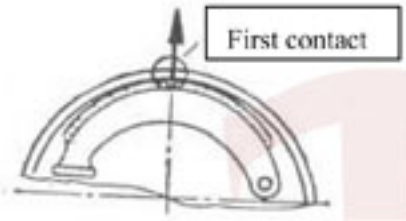


Fig. 8 - 9 Contact of brake shoe middle

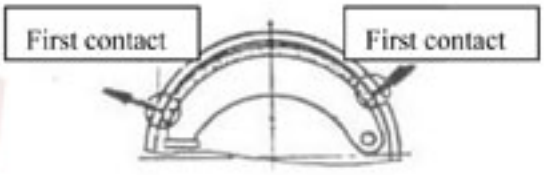
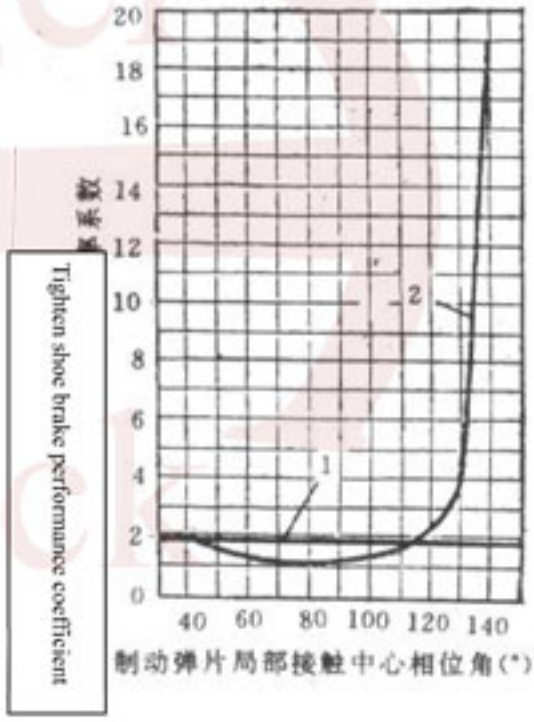


Fig. 8 - 10 Contact of two-end brake shoe and brake drum

3) Anastomosis of two ends of shoe and drum

When the shoe isn't opened, the two-end clearance between friction lining and brake drum is less than the middle clearance. If proper adjustment, when the shoe is opened, maybe first realize the anastomosis of two ends of friction lining and brake drum, and then realize the anastomosis the middle after two ends (Fig. 8-10). So, there are two contacts for each shoe and brake drum, the contact surface near to the middle will be increased and pressure distribution is uniform. The deformation of brake drum is smaller, working temperature of the brake is lower, but th



Otherwise, by the effects of friction force of friction lining end, the shoe creates the bend and the deformation to rapidly realize the anastomosis with the drum, and trend to the comprehensive anastomosis based on the abrasion and the brake increase.

Fig. 8-11 is braking performance change curve of brake friction pair of certain auto brake leading

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plate of brake shoe are contacted, the braking performance is better than the middle contact and the braking torque is big.

From above analysis, it is impossible to make synchronously comprehensive anastomosis, and the braking performance of first two-end anastomosis is better than first the middle anastomosis. And for their abrasion during use, the contact area of them is gradually increased and trend to realize comprehensive anastomosis, and improve the braking performance and the life of shoe and drum is longer. When the brake is repaired, the anastomosis between shoe and drum should realize the middle after two ends. Measure: when friction lining is added, the brake shoe radius is larger than the radius of brake drum, that is to say, R shoe is more than R drum.

8.2.3 Unbalance of wheel brake at two sides of the same axle

Wheel brake at two sides of the same axle should be equal to ensure the braking stability. If wheel brake at two sides of the same axle is unequal and two-wheel braking deceleration is unequal, the auto can create running deviation. Reasons cause the unequal brake of left and right wheel are followed:

(1) The friction coefficient at two sides of wheel brake is different. As mentioned above, the material and surface quality of friction pair is different and working temperature of the brake is not the same, etc., and all can create the difference of friction coefficient.

Fig. 8 - 11 Braking performance coefficient curve of certain auto brake

1 - Uniform contact of frictional plate brake shoe

2 - Partial contact of frictional plate brake shoe

(2)The pressure of two-wheel brake shoe to the drum is unequal. The pressure between shoe and drum is one of mail factors determine the braking torque. Reasons cause the unequal pressure of left and right wheel shoe and drum mainly include the different two-wheel brake piping resistance, the different technology of left and right brake chamber or wheel cylinder, the unequal elasticity of return spring of shoe plate or the unequal clearance between shoe and drum. Otherwise, above factors affect not only the braking torque, but also the starting time of the braking action.

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connivent area of shoe and drum and the rigidity of brake drum is different, all can lead to the difference of braking torque. Therefore, when brake drum is processed, should guarantee the inner diameter of brake drum at two sides of the same axle is the same, and the tolerance should not be more than 1mm.

Besides above reasons, if the tire technology of left and right wheel (abrasion and air pressure, etc.) is different, the load quality is uneven and the suspension is different, all can destroy brake balance of left and right wheel to create running deviation when the auto brakes.

8.3 Disassembly and maintenance of brake device

8.3.1 Disassembly of brake device

(1) Disassembly of brake

1) Release brake handle and remove parking brake
2) Unscrew the nut of back wheel, and then peak the auto supported by the bracket, disassemble the wheel nut and take off the back wheel;
3) Loosen the drain plug and clean up gear oil of rear axle house;
4) Pull out the brake drum by two bolts;
5) Turn the brake shoe by nipper pliers to impact the pin, and remove the brake shoe to press the spring;
6) Take off the parking brake cable from pull rod of parking brake shoe, and dismantle brake shoe;
7) Take apart the fixed clip of parking brake cable, and disassemble parking brake cable from brake carrier;
8) Draw out the brake fluid in brake oil pipe by absorbing cylinder, and then unscrew the connecting nut of brake pipe from wheel brake pump to remove brake pipe;
9) Immediately install the tubing plug to all brake oil pipes and brake pumps to avoid spill the brake fluid out;
10) Unscrew the erection bolt of wheel brake pump and remove the brake pump;
11) Disassemble the fitting nut of brake carrier from rear axle housing;

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13) Thin bearing shield ring by grinding machine, and remove bearing shield ring by chisel;

14) Remove the bearing from half axle by special tooling, and then remove brake carrier.

(2) Disassembly of brake chief-pump

1) Cut off the lead of fluid cylinder;

2) Clean the cover of the fluid reservoir casing and clean out brake fluid in the casing by sucker;

3) Dismantle brake hose on the fluid reservoir casing, and remove the bracket nut of the fluid reservoir casing to take off the fluid reservoir casing;

4) Disassemble the connecting nut between brake oil pipe and brake chief pump to cut brake oil pipe from chief pump;

5) Remove two fixed nuts of brake chief pump, and dismantle brake chief pump from vacuum booster;

6) Disconnect dust shield of chief pump, and remove the spring shield ring from the pump piston cylinder;

7) Blow out back-cavity piston by compressed air;

8) Loosen off the locking screw of the piston;

9) Blow compressed air into the locking screw hole to blow out front-cavity piston;

(3) Disassembly of vacuum booster

1) Disconnect vacuum hose and booster;

2) Remove the connecting pin between U-shape yoke of push rod of vacuum booster and brake pedal arm;

3) Unscrew the fixed nut of vacuum booster, and remove vacuum booster from pedal bracket;

8.3.2 Maintenance of brake device

(1) Maintenance of drum brake

1) Check whether the drum brake is clean and there is any crack. Scrape the deep groove and measure the inner diameter of brake drum and check the abrasion of the working surface. If the abrasion of the working surface is serious or there is the right crack, etc.,

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2) Check the abrasion of friction lining of brake shoe. If the abrasion of any friction lining exceeds use limit, all friction linings of brake shoe should be changed.

3) Clean brake pump components of brake pump by brake fluid and check whether each component of the pump is worn, cracked, corrupted or damaged. If there is any badness, the components should be changed.

4) Check whether each spring of brake supporting rod is damaged, corrupted or the spring is bad. If there is any badness, the spring should be changed.

(2) Maintenance of brake chief pump

1) Check whether fluid reservoir casing of brake chief pump is leaked and distorted, and the cover of fluid reservoir casing is damaged and distorted, and brake hose is damaged. If there is any badness, all should be changed;

2) Check whether the shell and hole of brake chief pump is corrupted, damaged or cracked on the right, etc. If there is any badness, brake chief pump should be changed;

3) Check whether the inlet connector of brake chief pump has any aging, cracking or oil leakage, O-shape seal ring is reliable, outlet valve is bad and the spring is softened. If there is any badness, all should be changed;

4) Check whether the piston of brake chief pump is seriously damaged, return spring is softened, and piston cup has any aging and cracking. If there is any badness, all should be changed.

(3) Maintenance of vacuum booster

1) Check whether vacuum booster has any effect as booster. If it has any aging and dilapidation, the vacuum tube should be changed; If it has any badness, vacuum booster should be changed to the vacuum booster assembly;

2) Check the length of U-shape yoke of push rod of vacuum booster. If the length from the pin hole of U-shape yoke of push rod to the installation surface doesn't meet the required value, the length of the yoke should be adjusted, ant then the nut will be screwed to the prescribed torque;

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pump. If it doesn't meet the regulation, the clearance should be adjusted. Below is the adjustment method of the clearance between push rod of the booster and the piston of chief pump:

① Before it is measured or adjusted, the piston rod should be pushed repeatedly to ensure that the plate can be positioned; Inside pressure of the booster should be kept under the atmospheric pressure;

② Special tooling-measuring tool of the piston rod is installed on brake chief pump, and push the guide pin of piston rod until piston plane A is level with end face B of chief pump.

③ Reverse the special tooling and install the tooling on the booster, and check the clearance between push rod of booster piston and the pin head of special tooling. If the clearance doesn't meet the described range, the adjustable bolt of push rod of booster piston should be reversed in order that the clearance will be adjusted the defined value.

(4) Maintenance of parking brake device

1) Clean the surface of brake cable, and check whether the outer layer of the cable is cracked and the joint is damaged, and the core wire is broken. If there is any badness, the cable should be changed to the cable assembly;

2) Check whether the lockup toothed plate of parking brake handle and the ratchet are distorted or damaged, the lockup is reliable and released flexibly. If there is any badness, the handle should be changed to the assembly of brake handle;

3) Check whether return spring hook of brake cable is installed correctly, the spring is broken or distorted, and the elasticity is reduced. If there is any badness, all should be changed.

8.4 Assembly and adjustment of brake device

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1 . Assembly of drum brake

When drum brake is installed, following items should be paid attention to:

1) Wipe the waterproof glue on the contact surface of brake carrier and rear axle;

2) Install brake carrier and half axle on the rear axle, and screw the fitting bolt of brake carrier up to the defined torque;

3) According to the prescription, screw the torque to install brake pump on brake carrier;

4) Connect brake oil pump to brake pump, and the connecting nut of brake oil pump is screwed to the defined torque;

5) When parking brake cable is installed, wipe the waterproof glue on the contact surface of brake carrier and brake cable, and then parking brake cable will cross the brake carrier to be fixed by clip;

6) When the brake shoe is installed, press hold-down spring of brake shoe to the installation position, and hold-down pin is turned over 90° by needle nose pliers to make pressure spring positioned;

7) Before brake drum is installed, the right-angled screwdriver head is plugged between the supporting rod and the ratchet, and then press the ratchet down to gain the max. clearance between brake shoe and brake drum, and subsequently install brake drum.

8) Install the rear wheel brake and the wheel, and after general air of brake system is eliminated, step the brake pedal for 4-5 times at the force of 30KG so that the clearance between brake drum and brake shoe can reach the regulated value.

2 . Installation of brake chief pump and vacuum booster

When brake chief pump and vacuum booster are installed, following items should be paid attention to:

1) When brake chief pump is assembled, clean the components of chief pump by brake fluid. Change the new piston cup, and then the piston and the cup will be assembled

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2) When the piston components are assembled, according to the opposite order of the disassembly, firstly, install components of front-cavity piston to the cylinder body of chief pump, and secondly, assemble components of back -cavity piston and adjust the size of piston components, and finally, enclose the cylinder body of chief pump;

3) When locking bolt of the piston is installed, slowly push the piston inside, and then mount seal ring and locking bolt of the piston to screw down to the regulated torque;

4) When the pipe joint of brake chief pump is installed, the locking bolt of the pipe joint is screwed to the regulated torque;

5) Install the booster on the pedal bracket, and then mount U-shape yoke of the booster on brake pedal arm by pin and split pin, and the booster nut is screwed down to the regulated torque;

6) Install brake chief pump on the booster, and the connecting nut is screwed down to the regulated torque;

7) Connect the vacuum hose to vacuum tube of the booster. Notice when connecting, the arrowhead on the hose should be faced to the side of intake manifold, and fix the hose by the clip.

8.4.2 Adjustment of brake device

1 . Checkup and adjustment of free pedal travel

Check free pedal travel, if free pedal travel doesn't satisfy the standard value, should check whether the bolt of pedal arm axle and the pin of brake chief pump are loosened. If there is any badness, should be changed.

Standard value of brake free pedal travel: 8~15mm (oil brake), 25 ~ 35mm (gas brake)

2 . Checkup and adjustment of brake pedal height

Step down the brake pedal at the force of 30KG, measure the distance from brake pedal arm to cab arm and this distance should not less than the specified value. If the distance is too short, should

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the system or change brake shoe. For the auto with the booster, should check and adjust the length of push rod of the booster.

Standard distance from brake pedal to cab wall: ≧95mm

3 . Adjustment of the switch of brake light

When the brake pedal is stepped down, the switch of brake light should be connected, if there is any failure, the position of brake light switch should be adjusted. While adjusting, put up the brake pedal towards the driver and retain this position, and loosen the fixing nut of brake light switch and adjust the clearance between the contact of brake light switch and the contact surface of brake pedal to the standard value, and then locking nut is screwed to the standard value.

Clearance between the contact of brake light switch and the contact surface of brake pedal 0.5 ~ 1.0mm

Standard torque of locking nut 10 ~ 15N.m

4 . Checkup and adjustment of parking brake handle travel

(1) Checkup of parking brake handle travel

Hold the middle of parking brake handle, and slowly lift up parking brake handle at the force of 20KG until the booster is completely braked, and its ratchet travel should be 5~7 teeth.

(2) If parking brake handle travel is not included in the range of 5~7 teeth, the length of brake cable should be adjusted. While adjusting, unscrew the adjusting nut of brake cable and, and adjust parking brake handle travel to the specified range, and then screw the adjusting nut.

5 . Exhaust of brake system

After brake device is maintained and re-assembled and the piping of brake system is input the air or the brake fluid is changed, the piping of brake system should be exhausted. Exhaust methods of brake system are below:

1) First mount the brake pump of left rear wheel far to brake chief pump, and then mount the brake pump of right rear wheel, left-right front wheel in turn;

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fluid volume is half during exhaust;

3) Remove the bleeding plug, and connect the transparent plastic catheter to bleeding plug of wheel brake pump, and another end of the catheter is inset the vessel;

4) Step down brake pedal several times so that brake fluid in fluid reservoir casing can enter chief pump and brake piping, and then when brake pedal is stepped, unscrew 1/3 ~ 1/2 cycles of bleeding plug;

5) Step brake pedal again and again until there is no bubble in the transparent catheter, and then hold brake pedal by foot and screw the bleeding plug. Notice that brake fluid will be filled at any moment in course of exhaust, in order that brake fluid in fluid reservoir casing keeps above "MIN" scale mark to prevent the air from entering brake chief pump;

6) Remove the catheter, and re-assemble the bleeding plug of brake pump. And then press the piping to check whether brake fluid is leaked;

7) Fill brake fluid to fluid reservoir casing to specified "MAX" scale mark, but it had better not exceed this scale mark to avoid brake fluid pouring out to corrupt the body.

8.5 Maintenance of air brake device

8.5.1 Structure introduction

Wheel brake is the simple balance-type air brake. Upper and down brake shoe is tightly pulled by return spring so that platform of brake shoe is tightly pressed on brake cam, when it is turned, the cam opens the platform of brake shoe to stretch brake shoe, and the shoe clings to brake drum to realize the brake of the wheel.

8.5.2 Adjustment of the brake

(1) After changing brake shoe lining and re-work the friction surface of brake drum, or turning cam position of the supporting pin of brake shoe is changed because brake carrier is disassembled, so as to destroy the right contact status of brake shoe lining and brake drum, must

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① Loosen the fixing nut of the supporting pin of brake shoe and the nut of the fastening bolt of the camshaft bracket.

② Rotate brake shoe so that the marks of two shaft ends is faced towards inside oppositely.

③ Through repeatedly screwing the supporting pin of brake shoe and worn shaft of adjusting arm, brake shoe lining and brake drum can be completely attached, at this adjusted position, carefully screw the fixing nut of the bracket and the locking nut of the supporting pin. (Now, keep the position of the supporting pin and bracket of brake shoe invariable)

④ Worm shaft is unscrewed 1/2 ~ 2/3 cycles, and brake drum should be automatically rotated and not crash with brake shoe lining or other parts. Check by feeler gauge that the clearance range between brake shoe lining and brake drum should be:

Supporting pin end of brake drum	0.25 ~ 0.4mm
Camshaft	0.4 ~ 0.6mm
Difference of two shoes at the same end	<0.1mm

⑤ Push rod travel after brake chamber is input compressed air should be 25 ± 5mm.

(2) After brake shoe is worn, push rod travel of brake chamber is beyond 40mm, in order to reduce the clearance between brake shoe lining and brake drum, only need do partial adjustment. Methods are below:

① Don't rotate the supporting pin of brake shoe lining to prevent damaging the original good contact status.

② When it is adjusted, the front wheel faces the adjusting worm. For rear wheels, the worm is screwed at the counterclockwise direction (the clearance between brake shoe lining and brake drum is reduced) and is unscrewed at the clockwise direction.

Notice: it is wrong that the clearance is adjusted by screwing the push rod clevis of brake chamber to change the length and direction of push rod.

(3) When the auto brake is trouble by running deviation of front wheel (during braking,

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running deviation lining clearance of front wheel at another side. (or reduce one-side clearance of running deviation) If running deviation to the left, increase the lining clearance of right front wheel (adjust brake adjusting arm and increase push rod travel of brake chamber), or reduce the lining clearance of left front wheel (shorten push rod travel). When the worm shaft of brake adjusting arm is turned 1/4 cycle, push rod travel is changed about 6mm.

Reasons of adjustment: when brake chamber is input at the low pressure, the efficient area of brake chamber diaphragm is extended according to pushing surface of push rod. Since the increase of the efficient area of the diaphragm leads to increase the brake, it is larger than the brake reduce caused by the increase of the clearance between brake drum and brake lining, so that when the lining clearance is increased and push rod travel is extended, the efficient area of the diaphragm will be extended and the brake will be increased, on the contrary, when the lining clearance is reduced and push rod travel is shortened, the diaphragm distortion is small, the efficient area is small so that the brake is small.

Notice: this adjusting method is only used for running deviation of front wheel brake caused by the limited difference of the lining clearance of left and right front wheel (in the range of 1/3 ~ 1 cycles of worm shaft of brake adjusting arm). All running deviations of front wheel caused by too large lining abrasion, inconsistent performance of left and right lining, oil pollution of the lining, inconsistent adjustment of left and right hub bearing, inconsistent pendulum difference of left and right brake drum, etc., belong to the failure category, should separately removed based on the related reason.

(4) When axial movement value of brake camshaft is not less than 1mm, can suitably add adjusting washer.

(5) If the rear camshaft doesn't return, can loosen three bolts of rear bracket and adjust the concentricity of camshaft hole of two brackets. After the camshaft can rotate freely, screw the bracket bolt.

8.6 Maintenance of front and rear brake

1 Check whether the fixing bolt of brake carrier is loosened.

2 Brake shoe should be rotated flexibly on the supporting pin of brake shoe, in case of clip

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smear the suitable lubricating grease. If the supporting pin of brake shoe is loose, the bushing should be changed.

3 The brake camshaft should be added lubricating grease when the maintenance at 3000Km, in order that the camshaft can be turned over freely on the bracket hole, in case of clip and corrosion, etc., the camshaft should be disassembled to clean and remove rust, and smear the suitable lubricating grease.

4 When the distance from the surface of brake shoe lining to the rivet head is less than 0.5mm, the brake shoe lining should be changed. Or for the crack and chip shell of the lining surface, etc., the lining should be changed.

5 During running, if the clearance between brake shoe lining and brake drum of certain auto is changed often, should check:

① Whether brake adjusting arm is locked up worm shaft.

② Whether the locking nut of the supporting pin of brake shoe is screwed tightly.

6 Out-of-round of brake drum abrasion is permitted cutting, when cutting, must be positioned by the conical surface of bearing cups of wheel hub, and total trip of the friction surface in the brake drum to the bearing axis is less than 0.2mm. The difference of the Inner diameter of left and right brake drum of the same auto is less than 1mm.

7 For the return spring of brake shoe, carefully check two-end hook and make sure there is no crack. If it is rusted or failed, return spring should be changed.

8 The diaphragm of brake chamber should be good without any crack and aging; and different diaphragms with rubber compound recipes are forbidden installing on the left and right brake chamber of the same auto.

8.7 Analysis of common fault and experience diagnosis

Common faults of auto brake system include ineffective braking, braking failure, braking deflection and braking lag, etc.

8.7.1 Hydraulic braking system

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1) Phenomenon: when the auto was braked, the driver felt the deceleration wasn't enough; when the auto was braked emergently, the braking distance is too long.

2) Reasons:

(1) Oil leakage of chief pump, pump, piping or pipe joint;

(2) Lack of oil or no oil for fluid reservoir casing of chief pump;

(3) The brake fluid is metamorphic (thinning or thickening) or the deposit of the inner wall of the piping is too thick;

(4) There is the air in the brake fluid;

(5) The abrasion of the chief pump cup, the piston or the cylinder is too more;

(6) The abrasion of the pump cup, the piston or the cylinder is too more;

(7) The gasoline inlet of the chief pump, compensated hole or the vent hole of fluid reservoir casing is blocked;

(8)The outlet valve and oil returning value of chief pump is not sealed or the pre-tightening force of return spring of the piston is too small;

(9) The front transfixion hole of the chief pump piston is blocked or the chief pump cup has the pastiness and the swell;

(10) The pump cup has the pastiness and the swell;

(11) The turbocharger or the booster is inefficient or has the failure;

(12) The oil pipe is collapsed or the inner hole of the hose is blocked;

(13) The free brake pedal travel is too large;

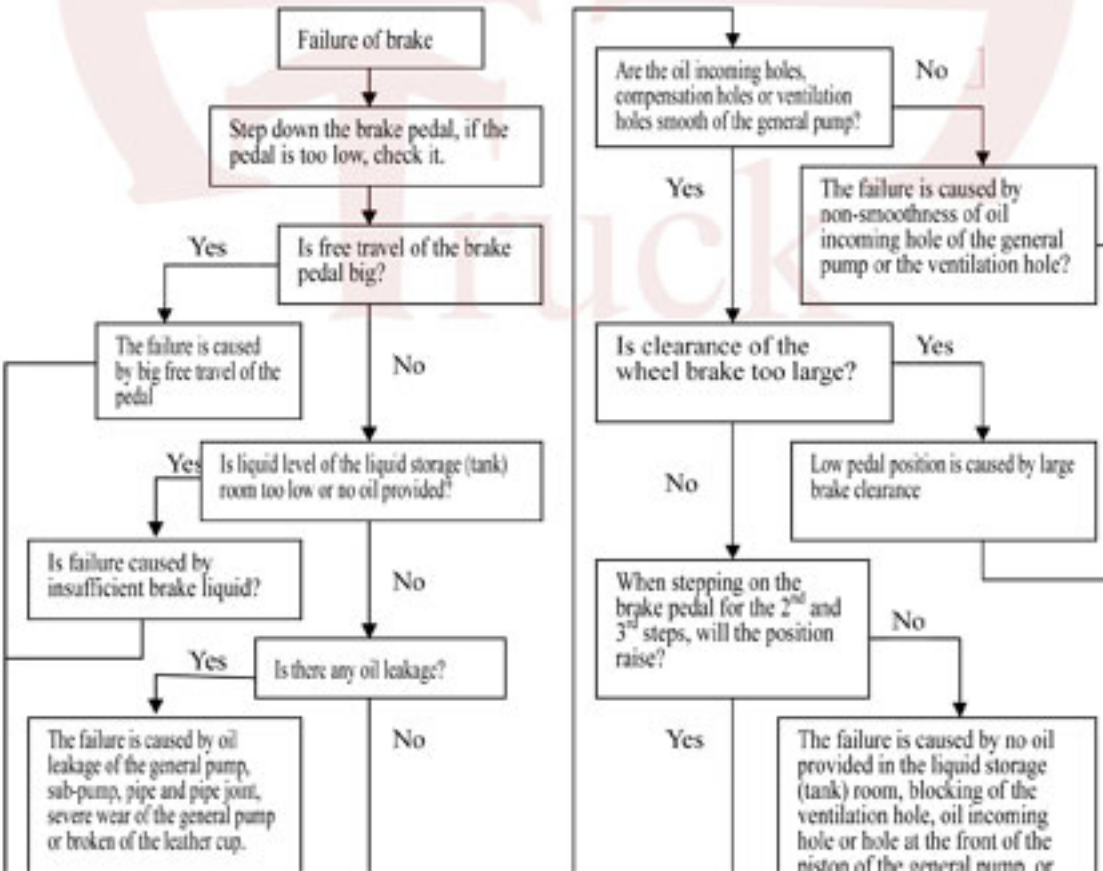
(14) The connivent surface of the brake shoe lining and brake drum (tray) is bad or the brake clearance is adjusted improperly;

(15)The quality of the brake shoe lining is not good or during using, the surface is hardened,

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(16) The abrasion of brake drum is too more or during braking, it is distorted.

3) Diagnostic method: refer to below flow chart (Fig. 8 - 12) to diagnose.



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Fig. 8 - 12 Diagnostic flow chart of Ineffective braking

2 . Braking failure

1) Phenomenon: when the brake pedal was stepped, the auto was not decelerated, even if continuous several steps, there was no obvious deceleration.

2) Reasons :

(1) There is no brake fluid in chief pump;

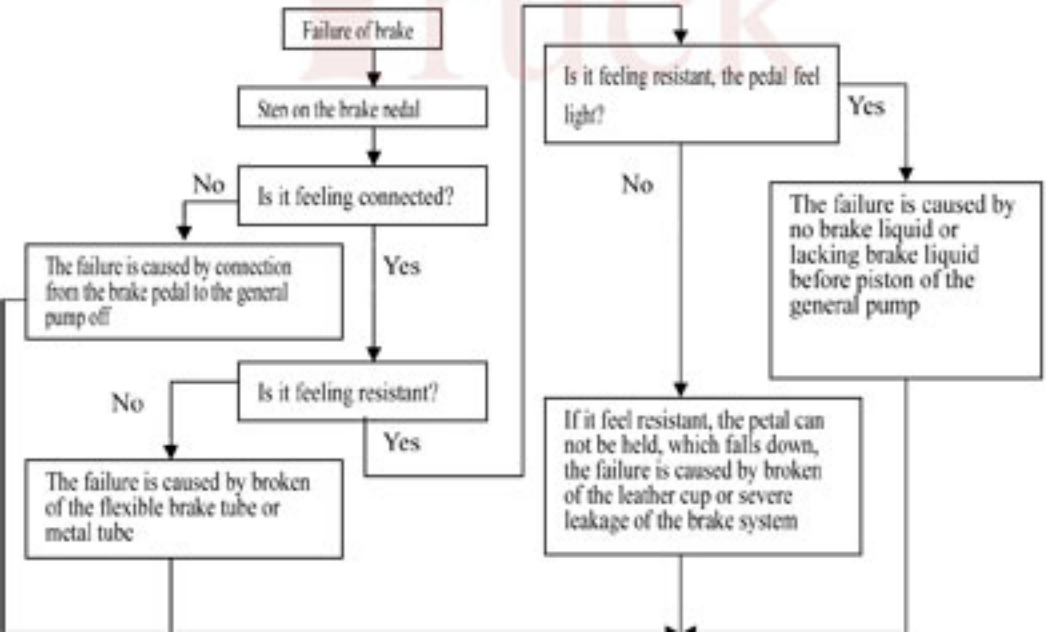
(2) The chief pump cup is seriously broken or the brake system is seriously leaked;

(3) The brake hose or the metal pipe is ruptured;

(4) The connection is cut from the brake pedal to chief pump.

3) Diagnostic method: refer to below flow chart (Fig. 8 - 13) to diagnose.

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Fig. 8 - 13 Diagnostic flow chart of braking failure

3 . Braking deflection

1) Phenomenon: when the auto was braked, the driving direction was deflected; when the emergent braking, the auto happened the plunging into head and tail-flick.

2) Reasons :

(1) The material of brake shoe lining of left and right wheel is different or the new and old material is different;

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(tray) of left and right wheel is different or brake clearance is different;

(3) The technology of left and right wheel pump is different, so that the acting time is different or the tension is different;

(4) The return spring pull of brake shoe of left and right wheel is different;

(5) The tyre pressure of left and right wheel is different, the diameter or the pattern is different, or the pattern depth is different;

(6) The thickness, diameter, distortion and roughness of working surface of brake drum of left and right wheel is different;

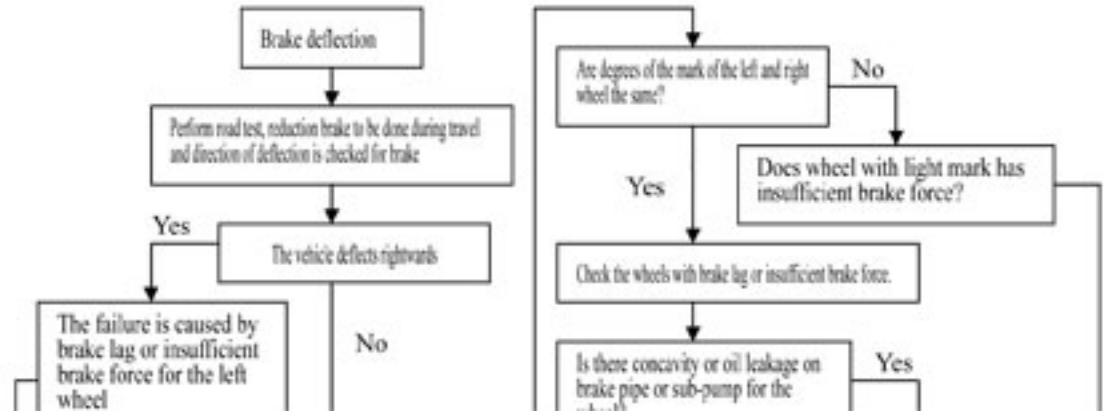
(7) Single-side brake piping is collapsed, blocked or oil leaked;

(8) There is the vapor lock in single-side brake piping or the pump;

(9) The connection between single-side brake shoe and the supporting pin is tight or rusted;

(10) The vehicle frame and axle are bent in the horizontal plane, the axle base at two sides of the frame is unequal or the rigidity of front steel plate spring is unequal, etc.

3) Diagnostic method: refer to below flow chart (Fig. 8 - 14) to diagnose.



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Fig. 8 - 14 Diagnostic flow chart of braking deflection

4 . Braking lag

1)Phenomenon: after brake pedal is lifted, braking action of all or separate wheels can not be

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2) Reasons :

(1) The brake pedal has no free travel;

(2) The connection of brake pedal and its axle is lake of oil, rusted or the return spring of the pedal is taken off and broken, and the pull is too small, etc.;

(3) The return spring of the chief pump piston is broken or pre-tightening forcing is too small;

(4)The length of chief pump piston and the cup is too large, or the cup has the swell and the pastiness;

(5) The compensated hole of chief pump is jammed by filth;

(6) The pump cup has the swell and the pastiness or the piston is caught;

(7) The return spring of brake shoe is taken off, broken or its pull is too small;

(8) The brake shoe and the supporting pin is rusted;

(9) The clearance between brake shoe and brake drum (tray) is adjusted improperly, and after the bake is loosened, the attrition is still existed partially;

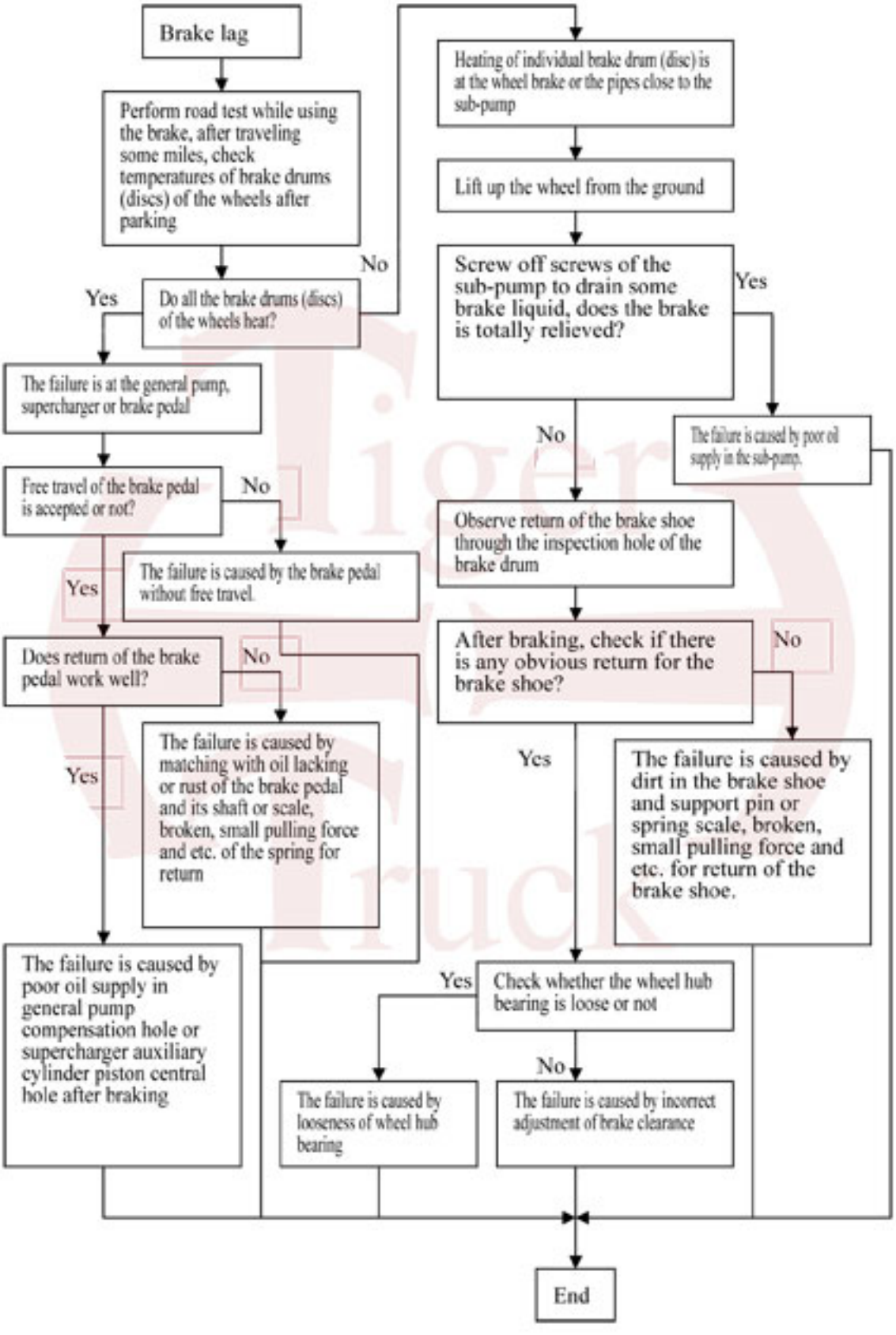
(10) The oil pipe through the pump is collapsed or blocked;

(11) When no braking, the piston center hole of auxiliary cylinder of the turbocharger can not be opened;

(12) The hub bearing is loosened.

3) Diagnostic method: refer to below flow chart (Fig. 8 - 15) to diagnose.

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Fig. 8 - 15 Diagnostic flow chart of braking lag

8.7.2 Air braking system

1 . Ineffective braking

1) Phenomenon: the same to ineffective braking of hydraulic braking system.

2) Reasons :

(1) The free travel of brake pedal is too large;

(2) The air-reserve tank can not reach the specified air pressure;

(3) Max. air adjusting bolt of brake valve is improper to make brake air pressure lower;

(4) Pre-tightening force of the balance spring of brake valve is too small, and the keeping brake is earlier;

(5) The diaphragm of brake valve is broken or exhaust valve is closed imprecisely;

(6) The diaphragm of brake chamber is broken or brake piping is leaked;

(7) The brake piping is collapsed or the inner hole of the hose is blocked;

(8) The connivent area between brake shoe lining and brake drum is not good or brake clearance is adjusted improperly;

(9) The quality of the brake shoe lining is not good or during using, the surface is hardened, scorched, oil polluted and the rivet head is exposed;

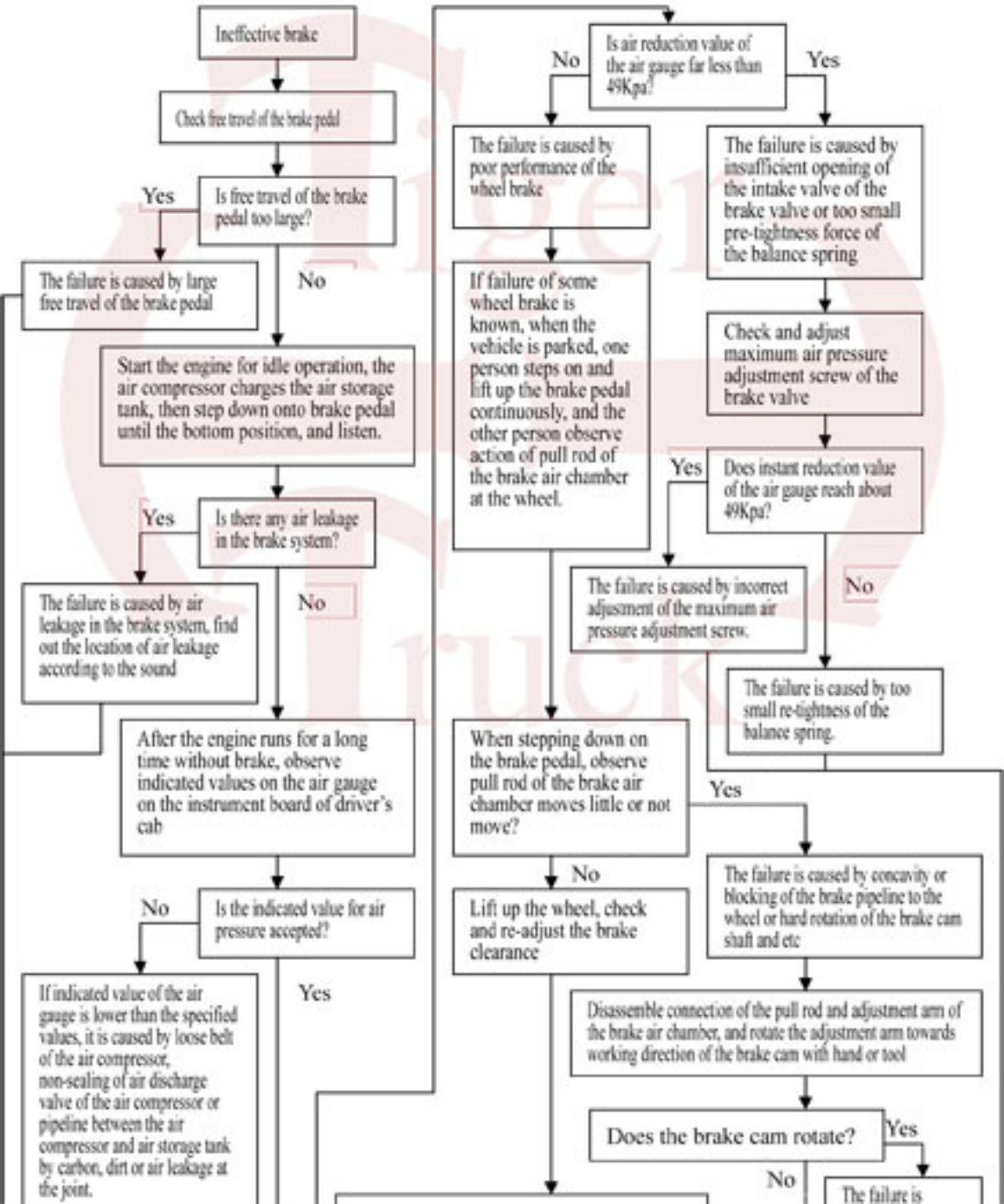
(10) The abrasion of brake drum is too more or during braking, it is distorted.

(11) The brake camshaft is rusted in the supporting sleeve;

(12) The deposit of the inner wall of the brake piping is too serious;

3) Diagnostic method: refer to below flow chart (Fig. 8 - 16) to diagnose.

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Fig. 8 - 16 Diagnostic flow chart of ineffective braking

2 . Braking failure

1) Phenomenon: the same to braking failure of hydraulic braking system.

2) Reasons :

(1) The connection from brake pedal to brake valve is taken off;

(2) There is no compressed air in air-reserve tank;

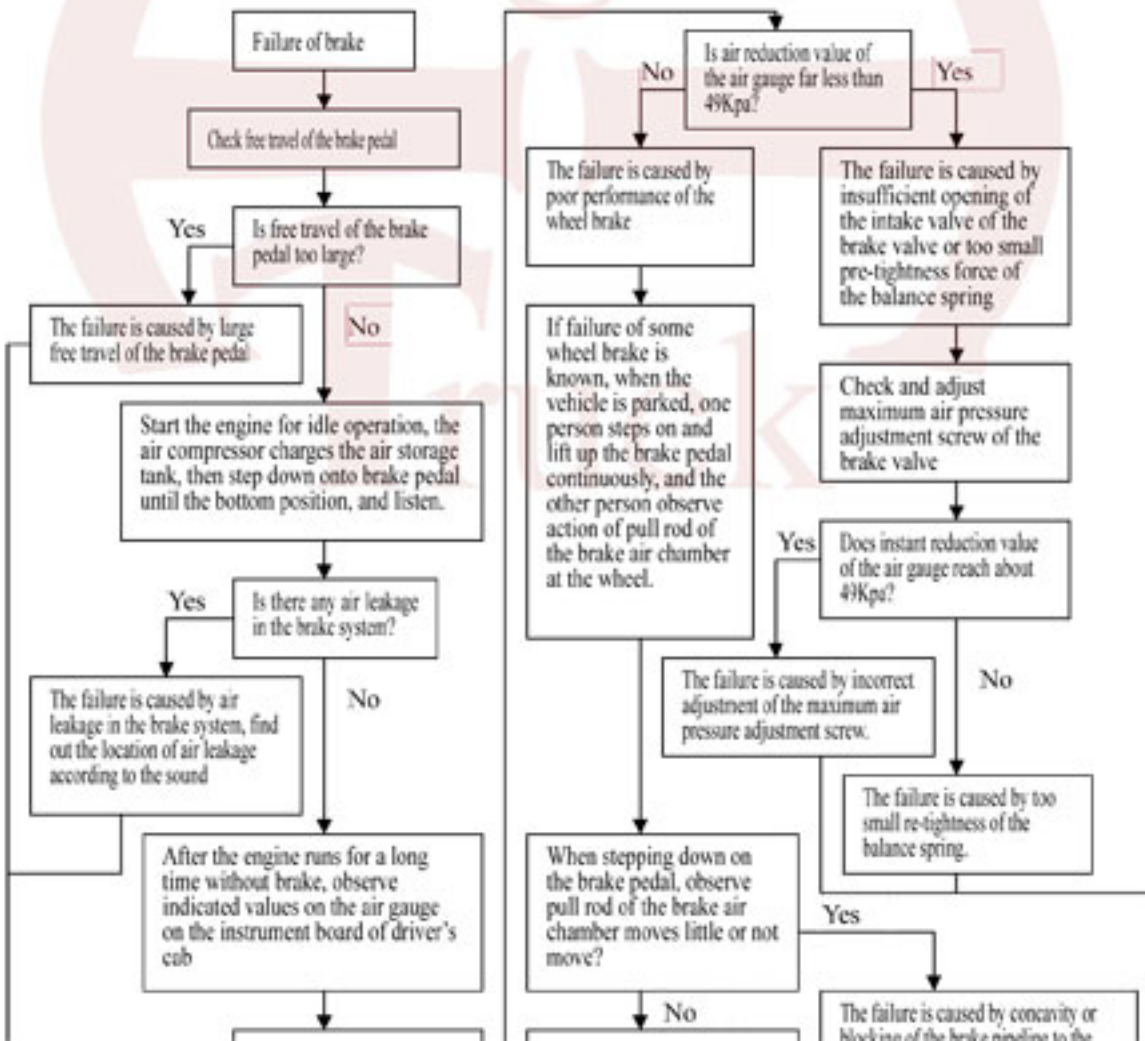
(3) The air inlet valve of brake valve can not be opened or exhaust valve is closed imprecisely;

(4) The diaphragm of brake valve and brake chamber is seriously broken or the brake hose is ruptured;

(5) The brake piping is frozen or blocked by oil contamination.

3) Diagnostic method: refer to below flow chart (Fig. 8 - 17) to diagnose.

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Fig. 8 - 17 Diagnostic flow chart of braking failure

3 . Braking lag

1) Phenomenon: the same to braking lag of hydraulic braking system.

2) Reasons :

(1) The small free travel of brake pedal causes the start degree of exhaust valve of brake valve is too small;

(2) The exhaust valve spring of brake valve or the spring causes exhaust valve to open is tired, broken or its elasticity is too small;

(3)The rubber valve surface of exhaust valve of brake valve has the swell and the pastiness, or the more oil contaminations and the colloids are piled at the valve port;

(4) The return spring of brake pedal is tired, broken and lost or its pull is too small;

(5) The return spring of brake chamber diaphragm (piston) is tired, broken or its pull is too

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(6) The return spring of brake shoe is tired, broken and taken off or its pull is too small;

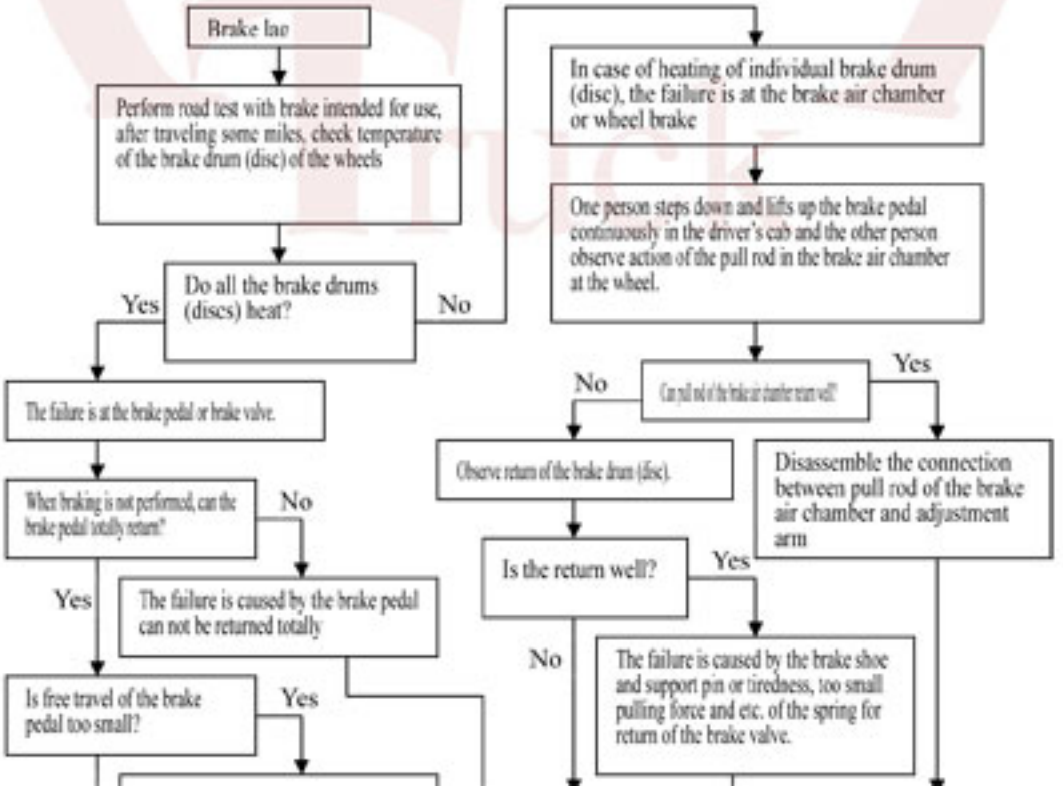
(7) The brake camshaft is lack of oil, rusted or blocked in its sleeve;

(8) The brake shoe and the supporting pin are rusted;

(9) The brake clearance is adjusted improperly, and after the bake is loosened, the attrition between brake lining and brake drum is still existed partially;

(10) The hub bearing is loosened.

3) Diagnostic method: refer to below flow chart (Fig. 8 - 18) to diagnose.



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Fig. 8 - 18 Diagnostic flow chart of braking lag

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Chapter 9 Frame, Wheel and Tire

9.1 Frame

The frame is the base body the whole vehicle and carrier for the support connecting the parts and bearing varieties of loads inside and outside the vehicle. The cargo carrying vehicle of SC series manufactured by the company employs the frame to fix the engine, transmission system, suspension, steering system and etc. The cargo carrying vehicle frame of SC series employs side-beam frame, owing to structure and use, the frame may be damaged, which affects safe performance of the vehicle. Considering the circumstances, timely and correct repair shall be give.

9.1.1 Wear analysis of the frame

During long-term use of the vehicle, the frame may suffer from deformation, cracking and rust and other losses caused by defects in structural design.

Deformation of the frame may lead to abnormal wear of the tire, the operation stability is poor, the brake performance worsens and oil consumption increases. Meanwhile, relative position of the assemblies of the automobile is changing and it is difficult to install the assemblies leading early damage.

Crack or breaking of the frame is generally on the longitudinal beam of the frame, and cracking or broken of the cross beam of the frame is on the connection to the longitudinal beam and middle of the cross beam. Cracking on the longitudinal beam of the frame is caused by bending stress and collective stress. If it is cracked during use, the result is severe.

Rust of the vehicle frame may reduce tiredness strength of the frame metal greatly to make reduce frame strength and early damage.

9.1.2 Testing of error of geometric of the frame

For the vehicle frame, no matter it is disassembled or not disassembled for repair, integrated testing shall be done before overhaul and after calibration, welding, riveting, reinforcement and assemble to determine degree of deformation of the frame, whether overhaul is required, result after overhaul and etc.

At present, main structure of the frame is side beam. Therefore, testing of geometric takes side

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affecting the testing precision caused by the flexibility by its weight.

(1) Check of deflection of the frame

aa'——Axis of pin supporting hole of front frame of the front steel plate;

bb'——Axis of pin supporting hole of back frame of the front steel plate;

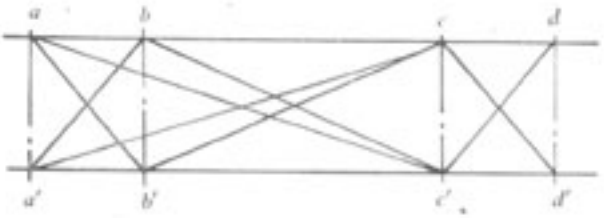


Figure 9-1 Wire-pulling test of frame by section

cc'——Axis of pin supporting hole of front frame of the back steel plate;

dd'——Axis of pin supporting hole of back frame of the back steel plate;

ab', a'b——Diagonal of section I;

bc', b'c——Diagonal of Section II;

cd', c'd——Diagonal of section III;

ac', a'c——Diagonal of section IV.

In general, after deflection of the frame, it can be inspected by wire-pulling of frame by section in Figure 9-1. The general method is that: selection a part with relatively large area on the frame as benchmark plane. Fix middle point of axis of pin support hole of the frame or the symmetrical points which are equidistant to the side of the frame on the steel plate spring, the four projection points on the benchmark plane are drawn to measure length difference of the diagonals among the four points.

For testing of frame by section, length difference of the diagonal may not be more than 5mm.

(2) Linearity inspection of longitudinal beam of the frame

Non-conformed linearity of longitudinal beam of the frame will affect installation of relevant assemblies. Therefore, check and calibration are required. The linearity error testing is divided into longitudinal linearity on the plane and side on the longitudinal beam of the frame. After completion, longitudinal linearity error of plane and side on longitudinal beam of the frame may not be more than 3mm in any length of 1000mm. In the overall length of the longitudinal beam, the error may not be more than 1/1000 of the length.

Please note that this is the requirement for longitudinal beam under assembly. For length of the longitudinal beam is too long and width is too narrow, requirement of the longitudinal linearity

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Linearity of the longitudinal beam can be tested by the wire-pulling method, see Figure 9-2. Cushion block 1 with the same thickness is on both ends of the testing plane of the longitudinal beam, and pull the wire against external plane of the cushion block. Then the steel ruler is used to measure distance of the points on the plane and wire on the longitudinal beam. The maximum value with thickness of the cushion block is the linearity error.

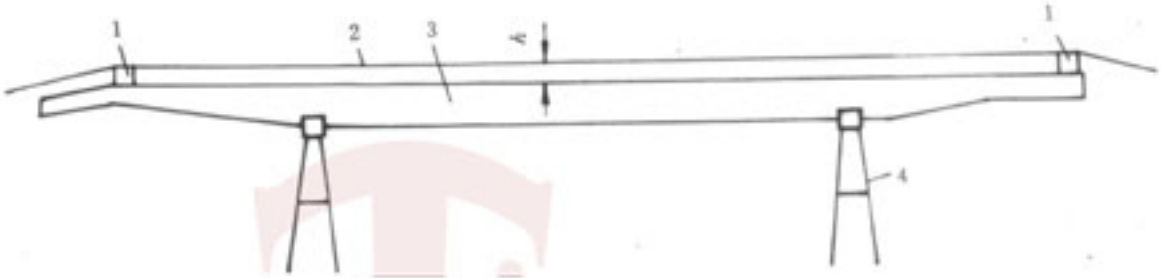


Figure 9-2 Linearity testing of longitudinal beam of the frame

1-Cushion block; 2-Silk line; 3-Longitudinal beam of the frame; 4-Support

(3) Planarity testing on the plane of the frame

If the testing meets the linearity requirement on the plane of the longitudinal beam, when one longitudinal beam bends upwards 1/1000 of the length, and the other longitudinal beam bends downwards 1/1000 of the length, relative error of the two longitudinal beams on the plane reach 2/1000. Or when the frame is distorted, the two longitudinal beams will not be parallel, which can not meet the technical requirements of the driver's cab, cargo carriage and passenger carriage, affect the vehicle appearance and make gravity center of the vehicle deviated. In case of turning centrifuge force or the road inclination, the operation stability, steering degree and force on the frame and etc. are affected. In addition, verticality error testing of side of longitudinal beam of the frame to plane of the frame in the following is based on the planarity requirement. For common side beam frame, planes on the left and right longitudinal beams on the frame assembly shall be one the same plane, and the planarity error may not be more than 1.5/1000 of the testing length of the plane.

For planarity testing of the planes on the left and right longitudinal beams, it can be tested with method described in Figure 15-3. There are 4 cushion block of the same thickness symmetrically placed on both longitudinal beams of both ends of the tested planes, the diagonals ab' and a'b. If the two diagonals are not contacted at point c, add gasket of the same thickness for both ends of

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points of the two diagonals form the benchmark plane. The wires ab and a'b' are pulled above the two longitudinal beams and measure the distance from points on the plane of the two longitudinal beams to ab and a'b'. Maximum difference of the distances is the planarity error on the plane of the longitudinal beam.

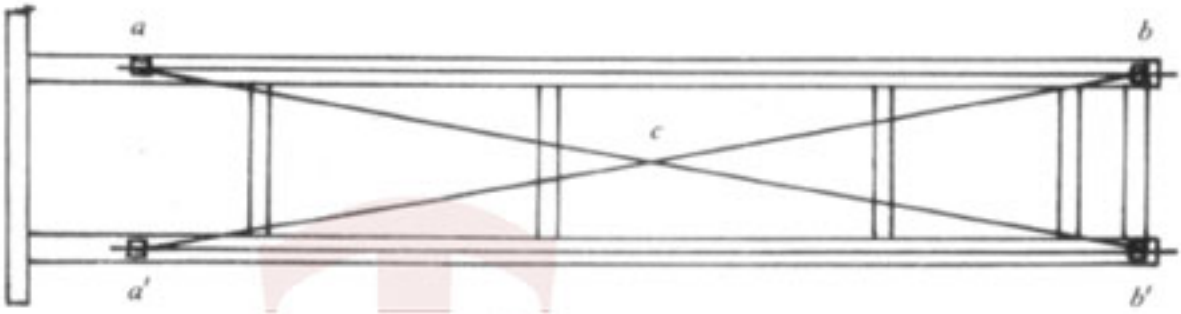


Figure 15 - 3 Planarity testing on longitudinal beam of the frame

(4) Other geometric error testing of the frame assembly

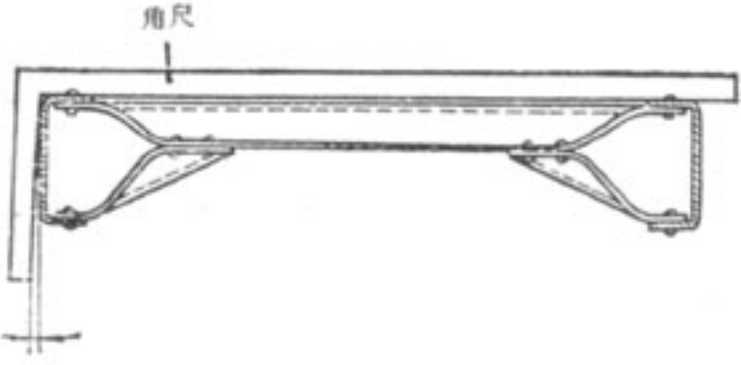
For common side beam frame, the following requirements must be observed after completion of overhaul:

(a) Limit deviation of the frame width is±3mm;

(b) Verticality error of side of the longitudinal beam to the plane on the frame may not be more than 1/100 of height of the longitudinal beam;

(c) Verticality error of main cross beams of the frame to the longitudinal beam may not be more than 2/1000 of length of the cross beam;

(d) Pin hole of fixed support of the left and right steel plate spring shall be co-axial, with coaxiality degree no more than 2.0mm. When the wheel base is no more than 4000mm, the left and right difference of axial of pin hole of the front and back fixing support shall be no more than 2mm; when the wheel base is more than 4000mm, it shall be no more than 3mm



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Testing of the verticality error can be performed with steel ruler as indicated in Figure 9-4.

Testing of verticality of the cross and longitudinal beams can be conducted by pulling wire in the middle position of the cross and longitudinal beams, then angle ruler is used to measure angle between the two wires.

Testing of coaxiality of pin holes of fixing support of the left and right steel plate springs can be done by using a measuring rod of effective size. According to the actual boundary value, the actual size is the algebra sum of the maximum actual size of the tested element and geometric tolerance.

Actual size = Maximum actual size± geometric tolerance ("+" for shaft, "—" for hole)

Prepare measuring rod of diameter 28.025mm with length little longer than external end surface space of the pin holes of the supports, the measuring rod can pass the left and right holes of the supports simultaneously and it is accepted. See Figure 9-5.



Figure 9-5 Coaxiality testing of support hole of the steel plate

9.1.3 Calibration of the frame

After testing the frame, if geometric error exceeds the permissible value, calibration can be done first. When the frame assembly is sound, there is only individual bending and deformation on the frame, and it can be calibrated on the frame directly. Figure 9-6 indicates common tools for

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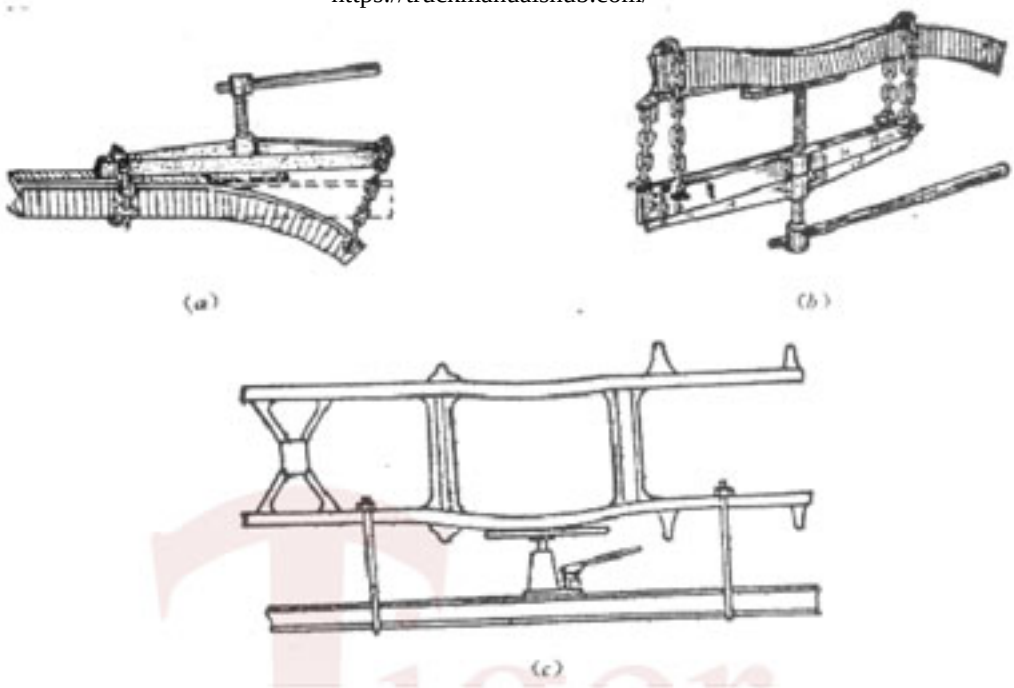


Figure 9-6 Tools for calibrating longitudinal beam of the frame

When the frame deformation is severe or looseness of the rivets is excessive, the frame shall be calibrated after disassembling. The frame is calibrated by cold pressing (drawing). For severe bending, the frame difficult for cold calibration or the service unit without frame calibration equipment, local heating can be used for calibration.

In the past years, according to the condition of more share of car in vehicles, a series of body calibration devices appear in the market. Without disassembling the car, compare the three-dimensional coordinate values on specified points and the standard values, and find out deformation of the body. Then the additional pressing and drawing devices are used to calibrate.

9.1.4 Frame repair and riveting

For longitudinal and cross beams of the frame, if cracking or breaking, displacement of rivet of the cross and longitudinal beams, looseness or breaking and etc. are found, it shall be repaired or riveting. For methods for repairing the cross and longitudinal beams, scarf patch repairing, butt joint, welding and addition welding and etc. are used. If there is defect on the rivet, the used rivet can be removed away and re-riveting.

(1) Scarf patch repairing of the frame

Scarf patching repairing of the frame is to remove the cracking of the cross and longitudinal

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thickness with the original frame.

When scarf patch repairing is used, remove old paint layer and rust on the frame, check size and location of the cracking. Then shape and size of the patch are determined according to nature and location of the cracking and manual gas cutting is used.

In vehicle repair, the patch shapes include oval, triangle, diamond, rectangle and etc. See Figure 9-7.

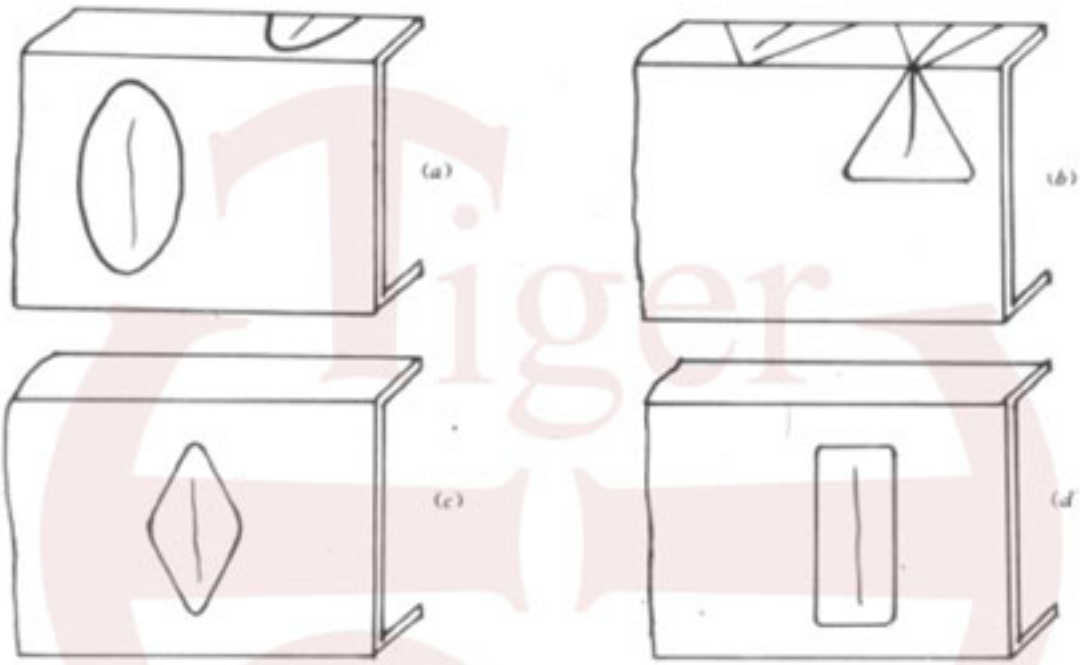


Figure 9 - 7

For cross cracking on the upper and lower planes of the longitudinal and cross beams of the frame and the side frame, longitudinal cracking or broken of the longitudinal beam, oval or triangle patch can be used for repair. Under general conditions, the patch shall remove all the cracks away. For security, for visual crack end, further 7-10mm patch is required. When cross and longitudinal crack on the sides of the longitudinal and cross beams appear, diamond or rectangular patch can be considered for repair.

When the scarf patch repair is used for repairing the frame, the patching cutting edge shall be smooth and clean and the grinding machine or manual chisel is used to open the groove. For forces on the vehicle are complicated, the strict conditions are severe, V or X groove is sued for edge of the cut and embedded plate for patch repair (see Figure 9-8), then double welding is used.

When scarf patch repairing is used, the scarf plates shall be repaired according to the patch size

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longitudinal beams of the frame, which shall be drawn from rejected from old frame of the same model and made of new steel plate.

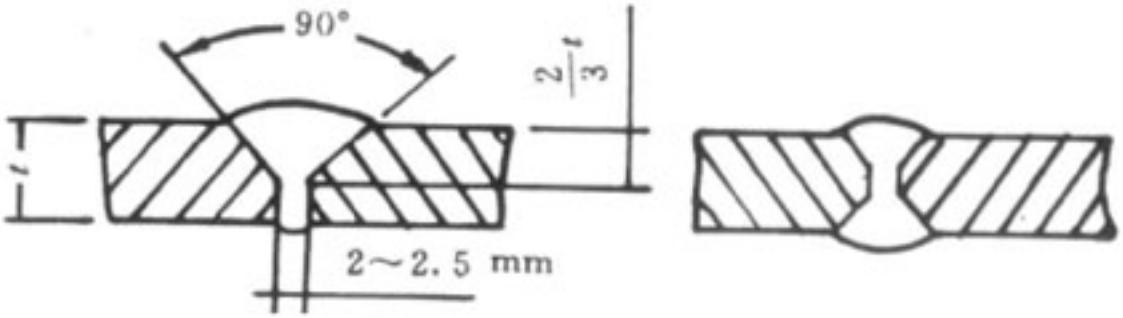


Figure 9-8 Groove shape and size

To ensure welding quality, a clearance of 2-2.5mm shall be preserved between the scarf plate and patch holes. Before welding, clean the groove surface, then the scarf plate is inserted into the patch hole and the scarf plate is fixed according to the weld point, then the flatness is calibrated. For working conditions of the frame has high requirement for the welding strength, correct soldering bar brand, diameter, welding current, number of layer and other welding specifications. In general, 502, 503, 506, 507 and 422 soldering bar can ensure welding quality, with diameter of the soldering bar 3.2-4.0mm. For welding, AC and DC power supply can be used (DC for 507 soldering bar). The welding current from 100-200 A can be selected upon diameter of the soldering bar and thickness of the plate. Surfacing welding can be used, generally 3-4 layers to avoid welding stress.

Short arc shall be used for welding to avoid air hole in melting metal. The seal shall be flat, smooth, without welding beading and crater, and the depth of undercut shall be no more than 0.5mm and the length of undercut shall be no more than 15% of the welding length, without air hole, slag and other defects. When repairing the frame, direction of the welding seam may not be overlapped or vertical with the crest line, except the special frame. There should be no crack on the welding seam or its surroundings.

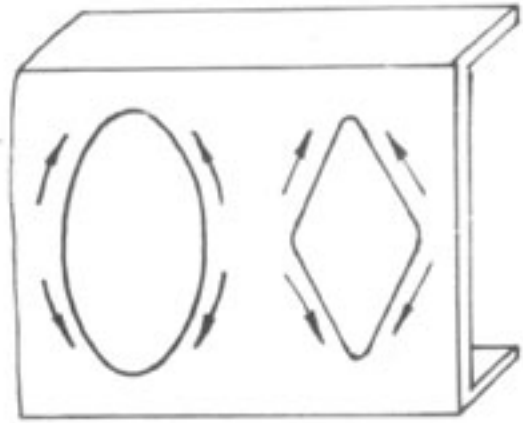


Figure 15-9 Direction of welding

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broken in use. When conducting welding, it shall be started from the middle of the sides of cross and longitudinal beams and extend along the opposite direction (See Figure 15-9) to lead the welding stress to the edge which becomes loose. After welding, flatten the bead; for the location not affecting the assembling, the bead can be 1-2 higher than the benchmark plane.

(2) Butt joint repair of the frame

For some section of longitudinal beam of the frame, especially within 1.5m of the front and back end of the longitudinal beam, if total broken or crack is collective, the damaged section (end) can be cut, and the butt joint welding can be used to weld a new beam (end) which is the same with the cut one.

For butt joint welding, it is divided into oblique mouth butt joint and flat mouth butt joint welding. For bead length of the oblique mouth welding is longer than that of the flat mount butt joint welding, the former one has more powerful quality guarantee. When cut of the oblique mouth butt joint is connected to the cross beam connected to the longitudinal beam and etc., the cross beam shall be dismounted and the repair becomes complicated, the flat mouth welding can be used. In other word, direction of the welding seam can not be vertical to crest line of longitudinal beam of the frame in general.

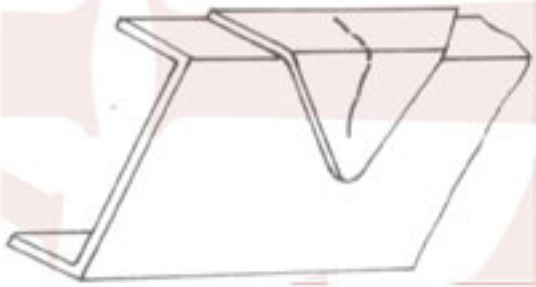


Figure 9-10 Additional welding repairing

When butt joint welding is used, the frame cutting, crater processing, welding specifications and requirements and etc. shall be the same as patch repair of the frame. Please note that, after welding of the butt joint section and the original longitudinal beam, check longitudinal linearity error of the plane and side of the longitudinal plane. After welding, check shall be conducted.

(3) Additional welding repairing of the frame

If regular crack or broken is on the specified part of the vehicle, there must be problem with the vehicle design or use. If it is caused by defect of the frame design, in addition to normal repair of the crack, reinforcement plate shall be used at the point, namely, additional welding repairing (see

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When additional welding repairing is used, the selected reinforcement plate shall have the same material with the original frame, with thickness a little less than the steel plate of the original frame, which can not be more than. Shape of the reinforcement plate can be triangle, and other shapes and the length shall be 2 times of height of the longitudinal beam. To make smooth toughness transition of local points of the cross and longitudinal beams after repair to avoid collective stress for broken caused by great different of toughness of the reinforcement point and other points of the original frame. In general, sizes of both ends of the reinforcement shall be reduced gradually. Please note that the rear longitudinal beam toughness must be coordinated.

Welding specifications of the reinforcement plate are the same with the patch welding. To avoid excessive increasing of the toughness, sectional welding can be used.

To avoid excessive increasing of weight of the frame and affect its economic use, after completion, the increment may not exceed 10% of the original design weight.

(4) Riveting of the frame

When repairing the vehicle, it most rivets are damaged or deformed caused by accident or severe operation conditions. If calibration of the longitudinal beam is difficult without disassembling, the frame can be repaired by disassembling the frame. By doing so, all the frame rivets will be removed away and re-riveted.

There are so many methods for removing old rivets, such as gas cutting method, drilling method, cutting method, removing method and etc. No matter what method do you use, you may not damage the frame and riveting hole. When wear of the old riveting hole is no more than 0.5mm, it requires no modification; if it exceeds the size but less than 2mm, expand the hole appropriately and employ a larger riveting. Once wear of the old riveting hole is more than 2mm, fill the old holes and drill new ones.

When riveting the frame holes, cold riveting is recommended and hot riveting can also be used. After cold riveting, the rivet is full in the rivet hole without cutting impact during working. For hot riveting, the heat expansion and cold contracting after cooling may generate impact cutting with the radial clearance. When riveting is conducted, fasten the longitudinal and cross beams of the frame, then the total geometric error is in the range of control, and riveting is conducted.

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rivet must be full in the hole. There should be no crack, deflection and missed on the rivet head. All the rivets can not be replaced with bolt.

Finally, the completed frame shall undergo rustproof treatment. During use, if individual rivet or steel plate for individual rivet is loose and riveting on the vehicle is not easy, it can be fastened with bolt. However, the bolt shall be specially prepared and the material is middle carbon steel, and the rod can be full in the rivet hole.

9.2 Wheel

9.2.1 Wheel structure

Wheel is a rotating assembly bearing load between the tire and axle, which is made up of wheel rib and spoke. The wheel rib is a part mounted on the wheel for supporting the tire and the spoke is a supporting part between the axle and wheel rib. The light-duty truck of SC series manufactured by the factory employs two-part wheel rib (see Figure 9-11). The spoke and wheel rib can not be dismounted permanently.

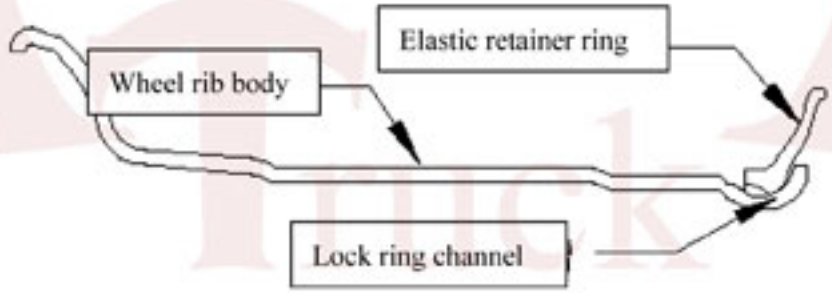


Figure 9-11Sketch map of the wheel rib

9.2.2 Maintenance of the wheel

(1) Dismount the wheel

a) Screw off the wheel bolt about 180°;

b) Lift up the vehicle;

c) Take the wheel off.

Note: Do not screw off the over-tightened wheel by heating, for heat expansion and cold contract

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(2) Maintenance

The wheel employs aluminum alloy casting processing, and welding, heating and sand spraying can not be used to repair the wheel. Therefore, all the damaged wheels must be replaced.

(3) Installing wheel

The wheel nut must be tightened to specified torque according to the sequence to avoid bending of the wheel or brake disc. The tightening sequence is the same as that for the engine cover.

Note: before installing wheel, remove rust on the wheel installation surface and brake disc surface or remove it with steel wire brush.

9.3 Tire

9.3.1 Tire structure

The light-truck of SC series employs common bias tire, which is made up of inner tire, external tire and cushion belt and etc. The inner tire is full with compressed air, and the external tire is a elastic shell used to protect the inner tire and prevent it from external impact; the cushion belt is placed between the inner tire and wheel rib to avoid collision and wear of the wheel rib and external tire. See Figure 9-12.

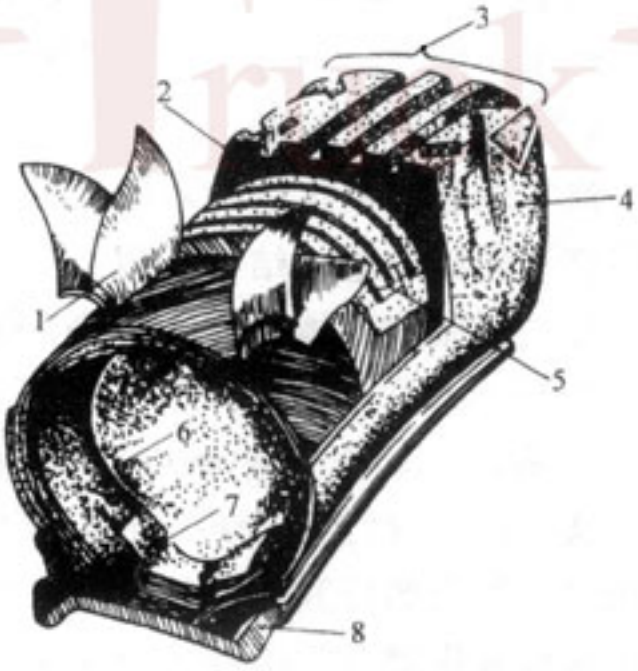


Figure 9-12 Structure of common bias tire with inner tire

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9.3.2 Maintenance of the tire

(1) Installation and disassembly

Tire replacement machine is used to mount or dismount the tire and the manufacturer's instructions must be observed. Not only the manual tool or tire pry rod is used to replace the tire to avoid damaging the tire edge or wheel rib. Steel wire brush is used to clean external edge fo the wheel rib or the lubricant, old rubber and a small amount of rust is removed. Before mounting or dismounting the wheel, appropriate wheel lubricant is used to lubricate the wheel edge.

(2) Tire maintenance

There are so many materials and methods for repairing the wheel. For not all the materials and methods are applicable for the tire, therefore, the tire manufacturers publish instructions on how to repair the tire timely, which can be obtained from the tire manufacturers.

(3) Tire pressure

For repaired tire, it shall be charged to specified pressure. If it is high, it may lead to: difficult driving, tire cracking or tire body damage; accelerated wear of central tire surface. If it is low, it may lead to: tire sounding for turning; difficult steering; accelerating wear of the tire edge which is uneven; crack or broken on the wheel rib; damage of the tire cord; tire with high temperature; low operation; increased fuel consumption and etc.

9.4 Technical parameters of the wheel tire

Table 9-1

Tire model	4.5J - 15	5.5F - 16
Tire model	6.00 - 16 common pattern 8-layer	6.50 - 16 common pattern, 10-layer
Tire pressure (Kpa)	420	530

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Chapter 10 Body and Electrical Equipment

10.1 Body

Automobile body is generally composed of body shell, external parts, internal parts, electrical accessories and packing case.

Body shell is the installing foundation for all components and is welded from longitudinal beam, transverse beam, pillar, stiffener, covering parts, engine hood, door, etc.

External parts refer to those parts that have functions such as protection or decoration for body exterior or external accessories that are used to realize certain function, including bumper, external decorative trims, sealing strips, external back mirror, radiator cowling, skylight and its accessories, door accessories, aerodynamic accessories, etc.

Internal parts are parts that protect human body or decorate inside car as well as ones that are used to realize certain functions, including instrument panel, seat, safety device, sun visor, internal back mirror, internal door decorating parts, internal underbody decorating parts and other internal decorating parts.

Body electrical accessories refer generally to all electrical devices except engine and underbody, including all kinds of instruments and switches, lighting apparatuses, light signal device, audio and video apparatuses, air conditioner, windscreen wiper, windscreen washer, defrosting device, anti-theft device, etc.

The follows are demonstrations for a part of parts.

10.1.1 Door and its accessories

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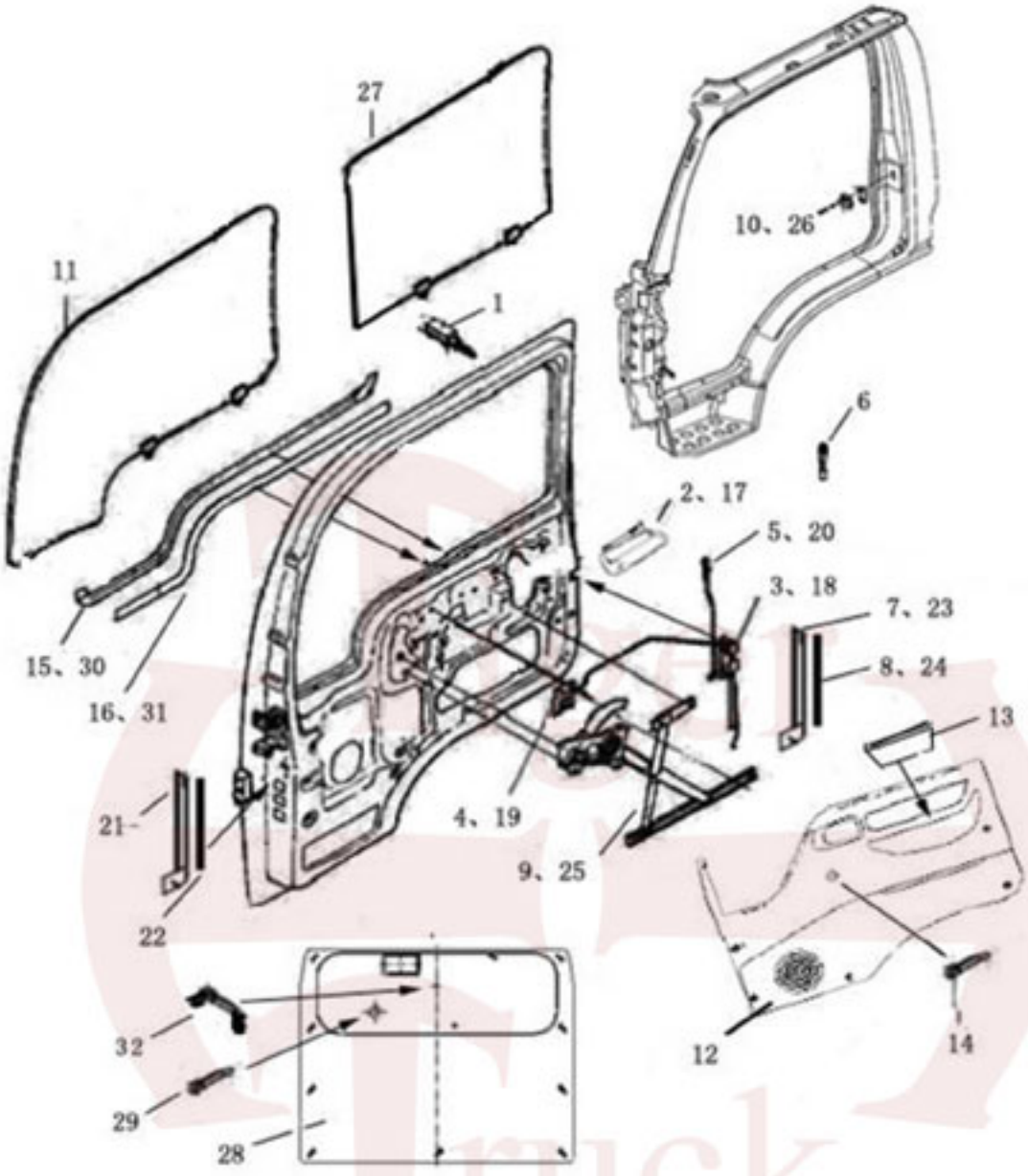


Fig. 10-1 Door device

1-door lock core device; 2, 17-external unlock mechanism assembly of door lock; 3,18-door lock assembly; 4,19-internal unlock mechanism assembly of door lock; 5,20-door locking mechanism assemble; 6-locking button; 7,21,23-window guide assembly; 8,22,24-window guide slot; 9,25-window lifter assembly; 10,26-lock pin assembly; 11,27-door window assembly; 12,28-inner fender; 13-inner fender ; 14-window lifter handle assembly; 15,30-window external batten assembly; 16,31-window internal batten assembly; 29-window lifter handle

(2) Disassembly of door and its accessories

1) Disassemble the fastening screw on internal handle seat using cross screwdriver, then take down internal handle assembly from internal decorating panel by sliding it forward.

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slot of lifter handle, pull the strip to make handle snap ring retract from the slop, take down lifter handle and dust cover.

3) Press the center of the internal decorating panel latch using cross screwdriver, disassemble the latch from its seat, then take down the internal decorating panel and sealing film.

4) Pry off internal and external sealing strips of front window using putty knife or flat screwdriver winded by adhesive tape, then disassemble internal and external sealing strips and their clamps.

Caution: when disassembling sealing strips, apply force evenly to avoid deformation or damage of sealing strips.

5) Loosen the assembling bolt of door slide slot and disassemble the rear part of front window slot, disassemble the fastening bolt of window support, take window together with support from inside door.

6) Unscrew the fastening bolt of window lifter using cross screwdriver, then take window lifter out from door hole.

7) Disassemble locking button, lock installing screw and clamps of lock control lever connectors from door, disassemble external handle and lock assembly from door.

8) Disconnect door wire bundle connector and disassemble bellows from car body.

9) Gently knock out door opening limiter pin upward using hammer.

10) Lift door by lifting jack. Caution: place a piece of wooden plate between jack and door skin to avoid damage of door.

11) Loosen hinge installing bolt and disassemble door assembly.

(3) Check of door and its accessories

1) Check the sliding of window lifter and the moving condition of rotating portions; check whether rack gear is worn or damaged and whether hinges are damaged. If

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2) Check whether internal or external sealing strips are damaged or peeled. If any, replace sealing strips.

3) Check whether window felt slot is damaged or deformed or whether the felt is peeled. If any, replace it.

4) Check whether window rubber batten is broken, damaged or aged. Check whether window support is damaged. If any defect, replace it.

(4) Adjusting of door and its accessories

Install door and its accessories in the sequence reverse to disassembly, but pay attention that:

1) Adjusting of lock: move the lock pin up and down to align it with the center slot of the lock; close the door, adjust the lock pin left and right to make the surfaces between the door and the body leveling; increase or decrease the number of gaskets between the body and the lock pin to adjust the longitudinal location so as to ensure that the longitudinal clearance between the lock pin and the body accords with the specified value.

2) When installing door window glass and bracket, apply the bracket slot with soap water, then knock the glass slightly into the bracket slot using wooden or plastic hammer and ensure that the relative location between the glass and the bracket accords with specified value.

3) Before installing the window lifter, apply the sliding portions and rotating portions of the lifter with lubricating grease.

4) After installing window assembly on the lifter, lift the window and check whether the top of the window contacts evenly with the felt slot as well as whether the slipping of the window is flexible. If the contact is not even, adjust the installing position of the lifter to ensure that it accords with the specification and that the window lifts smoothly.

5) Before installing the internal decorative board, apply the internal door panel with

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press the buckle in place. If the water-proof film leaks, remove it and reinstall.

6) Lift the window. Under the condition that the window is completely closed, adjust the angle of the lifter handle to 45°, install dust shield and press the buckle in place.

10.1.2 Windshield

(1) Disassembly of windshield

1) Disassemble accessories such as wiper blade, decorative parts, instrument panel, interior roof trims, rearview mirror, sun visor, etc. Clean the outer and inner sides of the windshield and its peripheral.

2) Scratch away the sealing strap around the windshield using knife and expose the peripheral of windshield.

3) Make a small hole in the viscose glue around the windshield using a piercer and pass steel wire through the hole.

4) Attach wooden rods to the two ends of steel wire and draw the steel wire along the windshield to cut the viscose glue.

5) Scratch the residual viscose glue away from the vehicle body using knife smoothly. Caution: the inserting depth of the knife should be 1-2mm.

(2) Installing of windshield

1) If the disassemble windshield is reused. The residual spacing strips and viscose glue on the windshield must be removed entirely.

2) Wash the residual viscose glue on the vehicle body and windshield with cleaning solution. Dry for more than 10min after applying.

3) Coat premier on the vehicle body coating and the exposed metal surface. Don't coat the premier on the residual viscose glue on the body.

4) Insert the windshield into the new fillet and spacing strip.

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6) Apply the adhesive edge of windshield with premier.

7) Apply the windshield edge with viscose glue.

8) Press the windshield into the vehicle body and knock the windshield surface and the around fillet slightly so as to install the windshield firmly. Fix the fillet on the top.

9) Spray water using hose to check whether the sealing strip of windshield leaks. If any leakage, fill the leaking place with viscose glue.

10.2 Electrical equipment

10.2.1 Lighting equipment

(1) Repair of head lamp

1) Check whether there is any tilt or looseness for the installing of head lamp. If any defect, fasten the installing screw;

2) Check whether the glass cover of head lamp is clean. If any dust or muddiness, clean it. Check the cover glass whether there are any cracks, damages or other defects. If any, replace it with new one;

3) Check the working condition of head lamp switch.

□ Check the working condition of lighting switch

Turn lighting switch from off position to stop I, head light, back light, license light and light for instrument panel should be turned on; turn lighting switch to stop II, head lamp, head light, back light, license light and light for instrument panel should be turned on.

□ Check the working condition of head lamp light switching

Turning on head lamp, push the switch handle upward, the head lamp should send far light; set the switch at the medium position, the head lamp should send near light; press the switch handle downward, the head lamp should send far

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(2) Adjusting of head lamp beam

1) Preparation before adjusting of head lamp beam: Adjust the pressure of four tires to the specified value, unload the vehicle, and then park the vehicle on the flat load surface. Set a blank screen or wall 10m in the front of the vehicle.

2) Adjusting of vertical beam of head lamp (Fig. 10-2): Turn on the far light switch of head lamp, the illuminating center of main beam of head lamp should be within the range between the center height H of head lamp and H/5D below H. If the position of main beam is not correct, change the position by adjusting the adjusting screw of head lamp so as to ensure that the beam center accords with the specification.

Fig. 10-2 Adjusting of vertical beam of head lamp

3) Adjusting of horizontal beam of head lamp (Fig. 10-3)Turn on the far light switch of head lamp, the horizontal position of the illuminating center of the main beam of head lamp should meet the following requirements: the deviation of the left head lamp beam to the left should not be more than 100mm and the deviation to the right should not be more than 200mm; the deviation of the right head lamp beam to the left or to the right should not be more than 200mm.If the position of the beam is not correct, adjust the adjusting screw of head lamp to ensure that the position of beam in the horizontal direction accords with the specification.

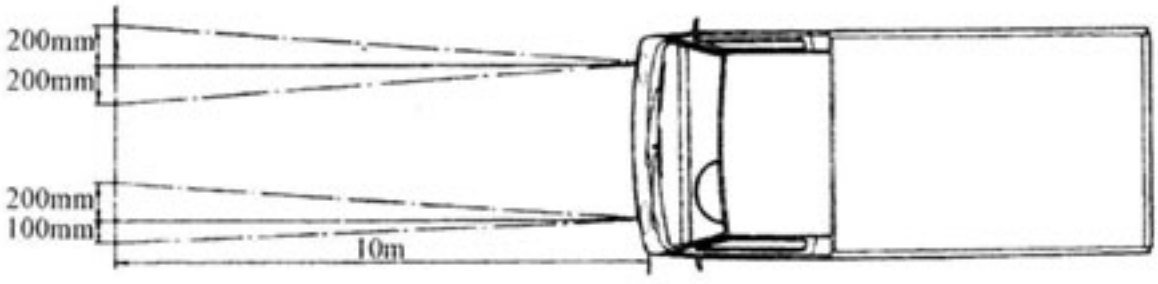


Fig. 10-3 Adjusting of horizontal beam of head lamp

10.2.2 Combined instrument

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1) Check of fuel indicator (Fig 10-4)

Disconnect the connecting wire between fuel indicator and fuel quantity sensor, connect a testing bulb (3.4W/V) between the indicator and the sensor; turn on ignition switch, the bulb should be turned off, and the instrument needle should begin to swing in several seconds; if any defect, replace the fuel indicator.

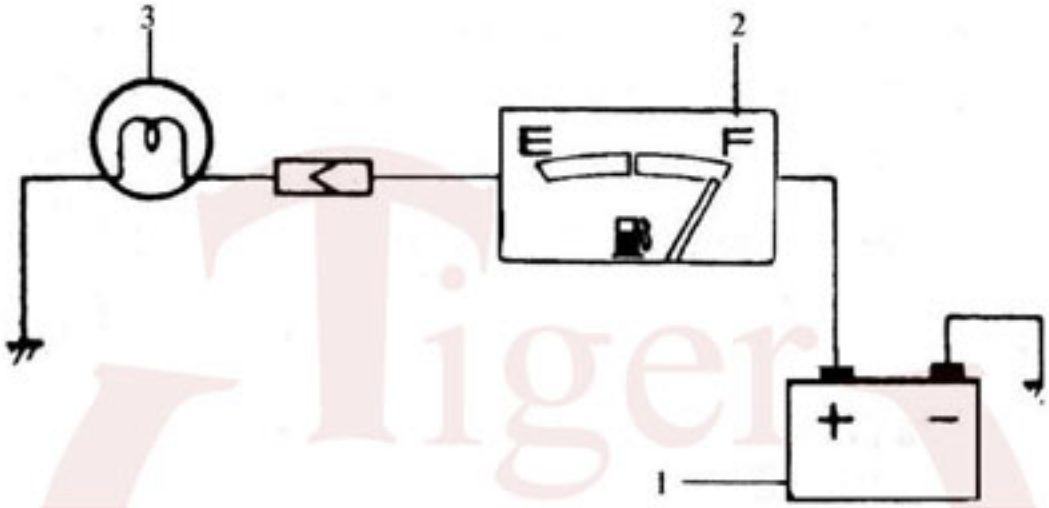


Fig. 10-4 Testing circuit of fuel indicator
1-battery; 2-fuel indicator; 3-testing bulb

2) Check of fuel quantity sensor (Fig. 10-5)

Take down the fuel quantity sensor from the fuel tank. Measure the resistance of fuel quantity sensor float at different heights using multimeter. If the measured resistance doesn't accord with the specified one of the correspondent location, replace the fuel quantity sensor.

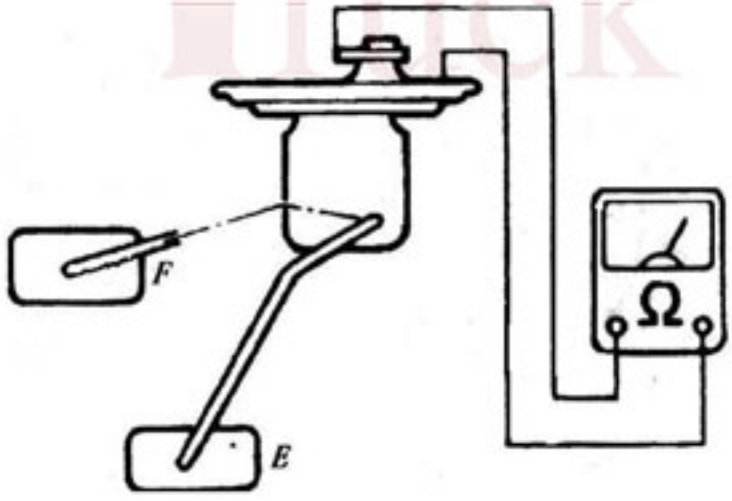


Fig. 10-5 Testing of fuel quantity sensor

Specified value of fuel quantity sensor: E (empty) 110Ω

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1/2 (half) 38Ω

3) Repair of water temperature indicator and sensor

a) Check of water temperature indicator (Fig 10-6)

Disconnect the connecting wire between water temperature sensor, connect a testing bulb between water temperature indicator and the ground wire; turn on ignition switch, the bulb should not be turned on, the instrument needle should swing in several seconds. If any defect, replace the water temperature indicator assembly.

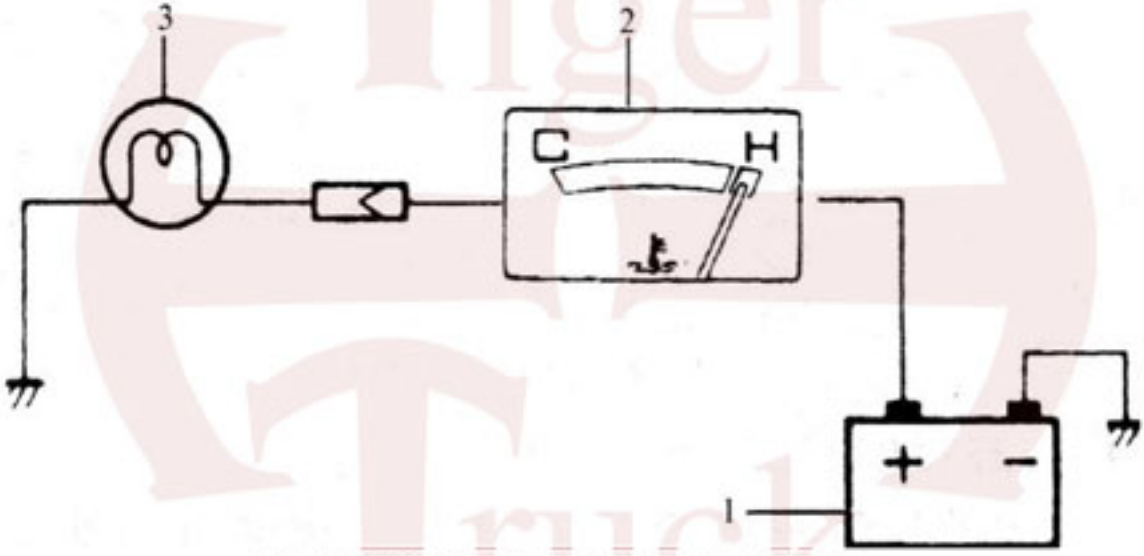


Fig. 10-6 Testing of water temperature indicator
1-battery; 2-water temperature indicator; 3-bulb

b) Check of water temperature sensor (Fig 10-7)

Heat the water temperature sensor, measure the resistance of the sensor using multimeter. If the measured value doesn't accord with the specified one, replace the water temperature sensor.

Specified resistance of water temperature sensor: 40□ 287Ω

80□69Ω

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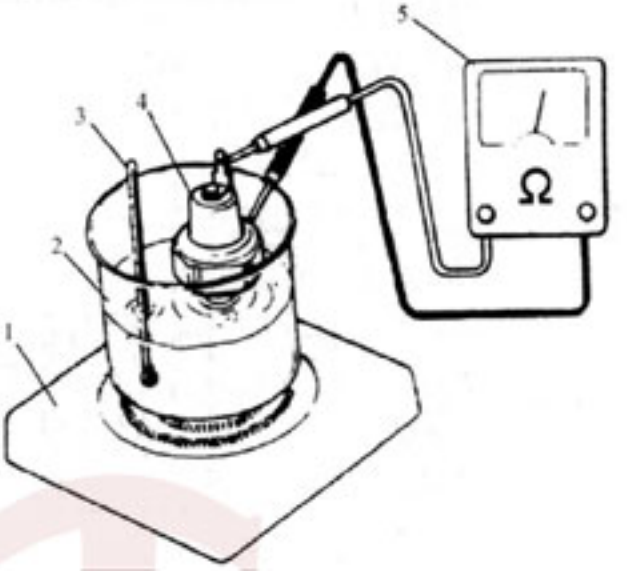


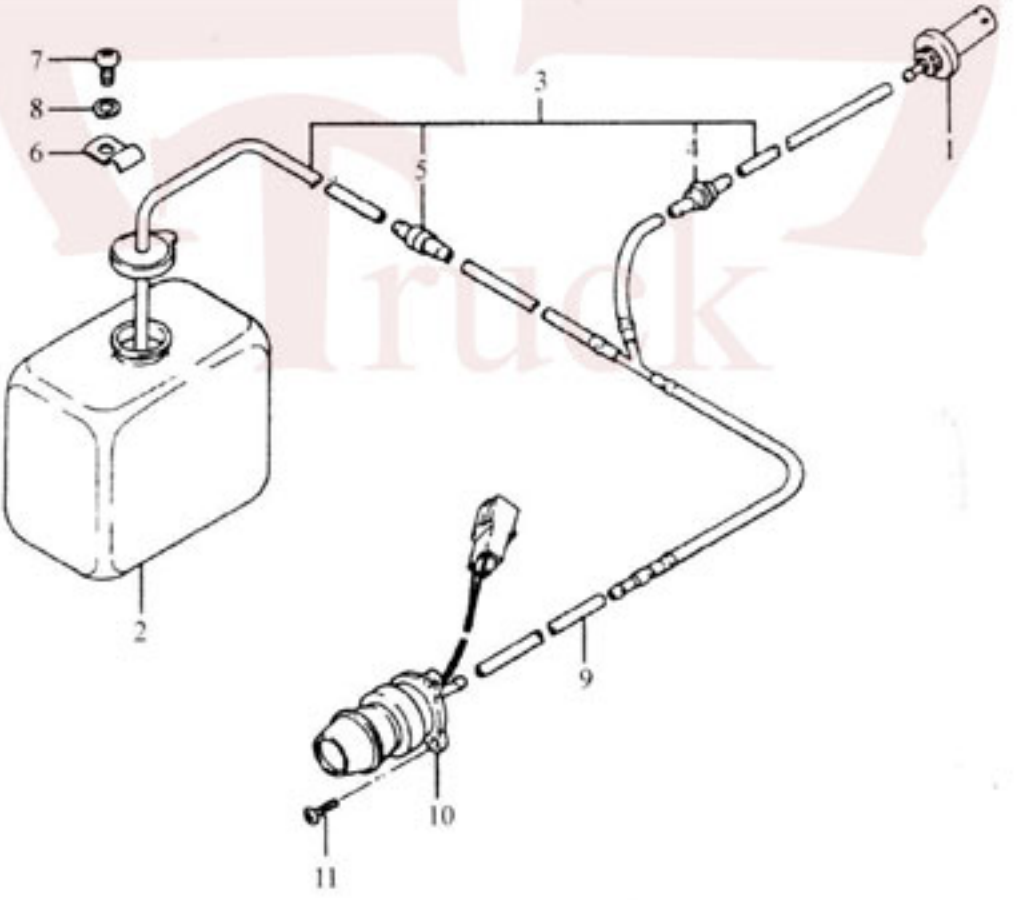
Fig. 10-7 Testing of water temperature sensor

1-electrical furnace; 2-beaker; 3-thermometer; 4-water temperature sensor; 5-multimeter

10.2.3 Windshield cleaner and wiper

(1) Structure of windshield cleaner

The structure and components of windshield cleaner are shown in Fig. 10-8.



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gasket; 9-hose; 10-water pump; 11-screw

(2) Structure of windshield wiper

The structure and components of windshield wiper are shown in Fig. 10-9.

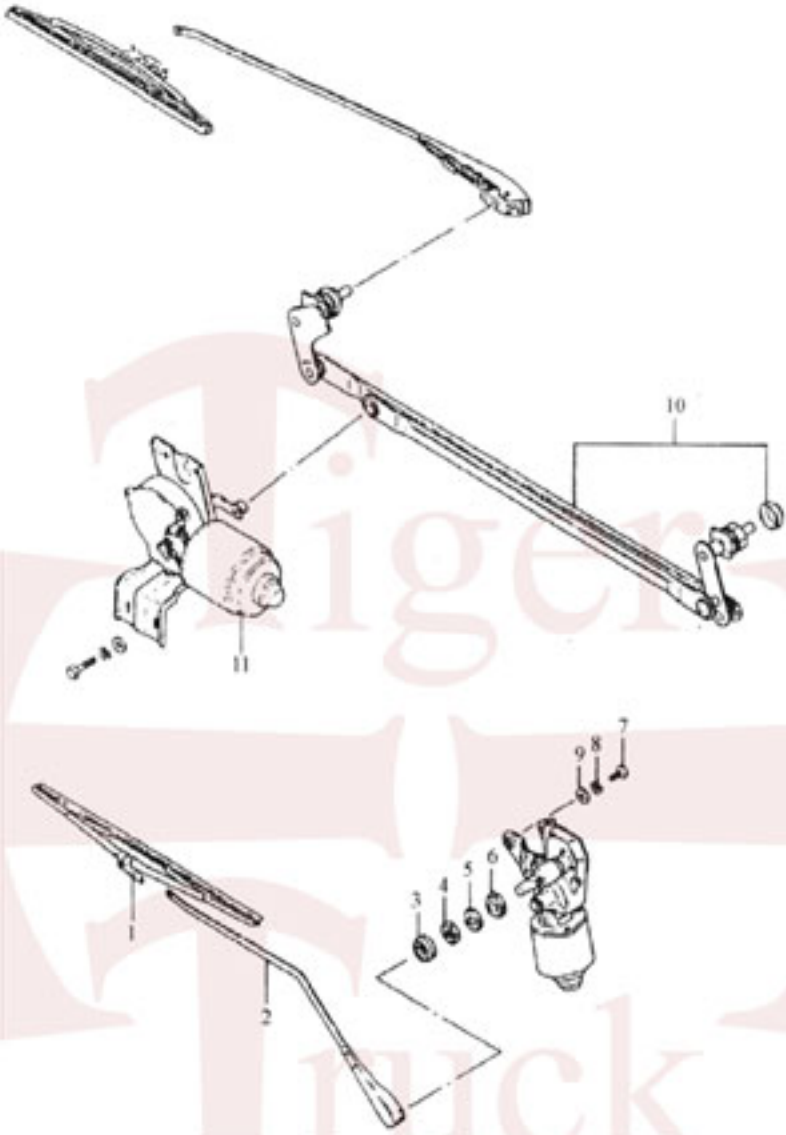


Fig. 10-9 Structure and components of wiper

1-wiper blade; 2-arm; 3-cover; 4-nut; 5-gasket; 6-seal part; 7-screw; 8-locking gasket; 9-gasket; 10-linkage; 11-motor

(3) Repair of windshield wiper

1) Check of working condition of wiper switch

Disconnect switch connector, check the continuity between terminals using multimeter to examine whether the wiper switch and sprayer switch have any defect.

2) Check of wiper motor

a. Idle running test (Fig. 10-10)

Check of low speed: connect the positive pole of battery to the blue wire of switch connector,

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Check of high speed: connect the positive pole of battery to the blue/red wires of switch connector, and the negative pole of battery to the motor gear case, the speed of motor should be 55r/min.

If any defect, replace wiper motor.

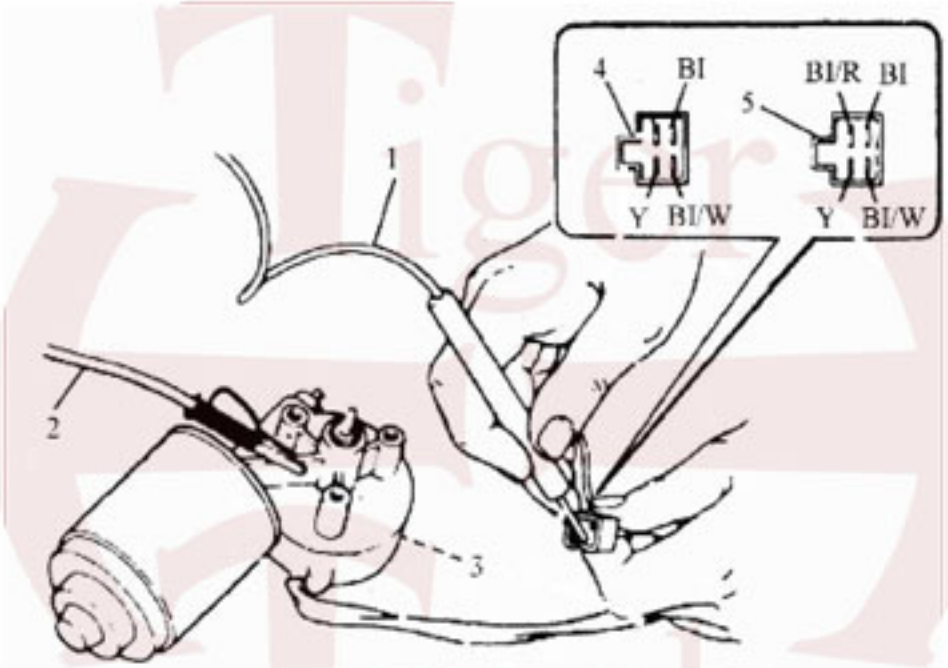


Fig. 10-10 Motor idle test

1-battery positive pole; 2-battery negative pole; 3-gear box; 4-double speed; 5-single speed

BI/R: blue/red; BI/W: blue/white; BI: blue; Y: yellow; Y/BI: yellow/blue

b. Test of automatic stop action (fig. 10-11)

Connect the positive pole to the yellow wire of the motor and the negative pole to the connecting wire of gear case to make the motor work. Then, shortcut the blue/white wire of switch connector and the blue wire using a jumper wire to check whether the position where the motor

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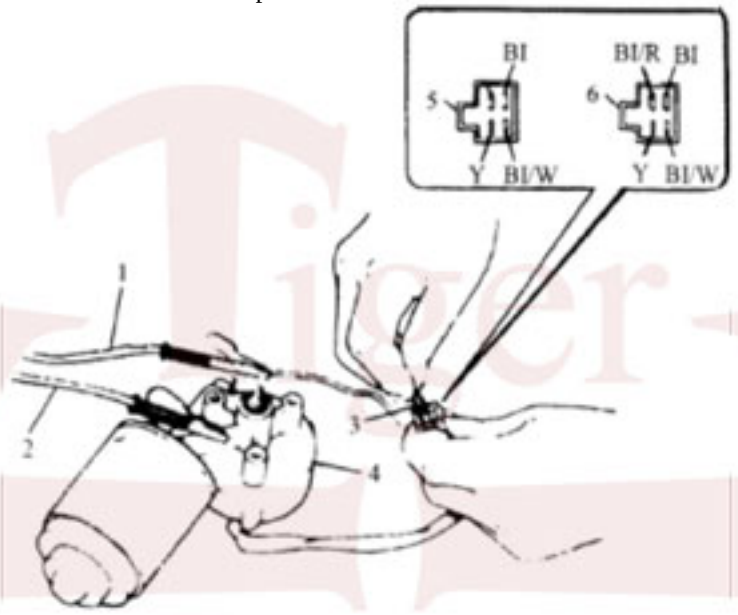


Fig. 10-11 Test of motor automatic stop action

1-battery positive pole; 2-battery negative pole; 3-jumper wire; 4-gear case; 5-double speed; 6-single speed

BI/R: blue/red; BI/W: blue/white; BI: blue; Y: yellow; Y/BI: yellow/blue

10.2.4 Heating device

(1) Structure and components of heating device (Fig. 10-12)

The heating device of chang'an truck is a type of water heating. It heats the air using cooling water of engine and sends the heated air into the truck by blower. Heating device is composed of

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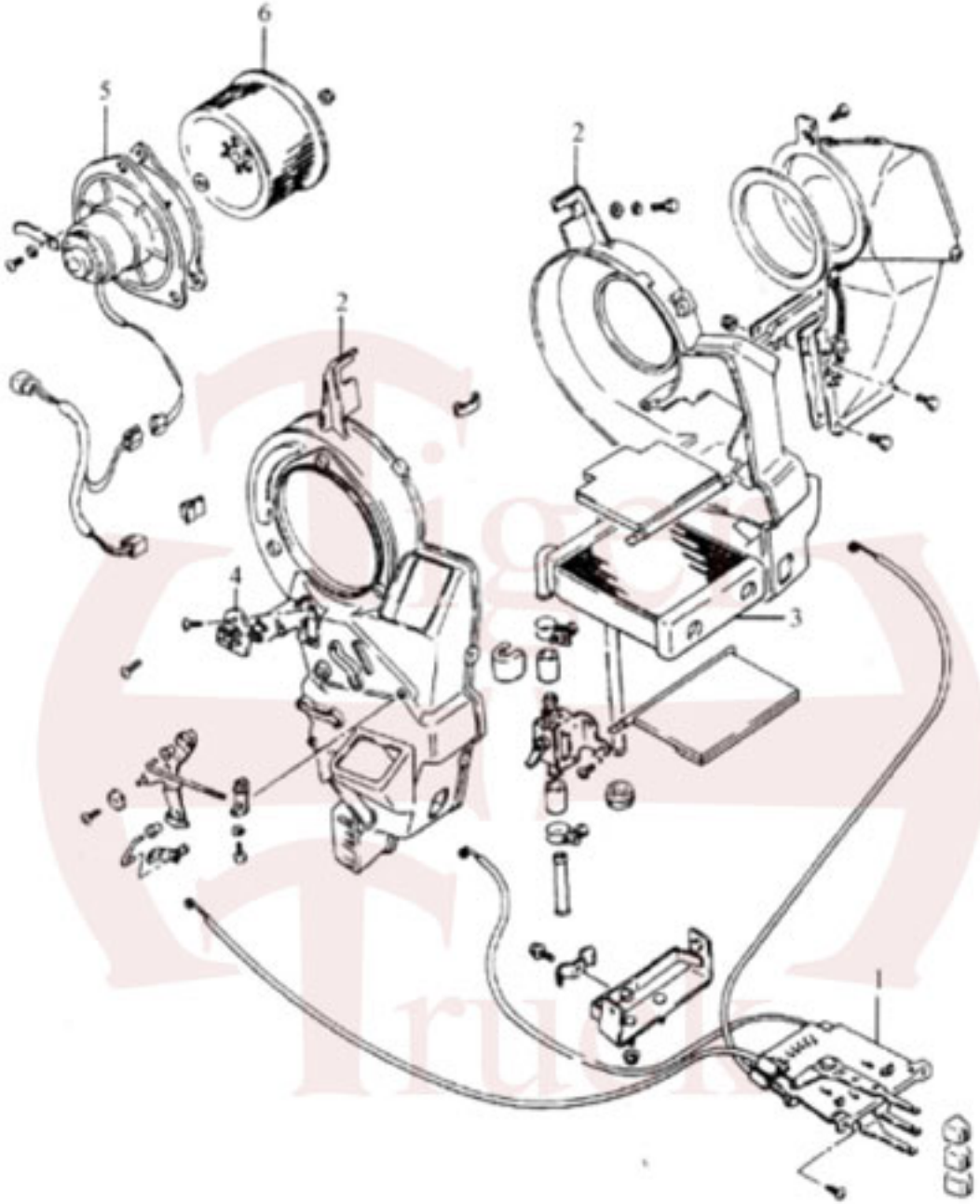


Fig. 10-12 Components of heating device

1-control lever assembly; 2-heater assembly; 3-heater core; 4-resistor; 5-blower motor; 6-blower

(1) Disassembly of heating device

1) Disconnect the negative pole wire of battery, drain engine cooling solution and remove heating hose on heating device (Fig. 10-13);

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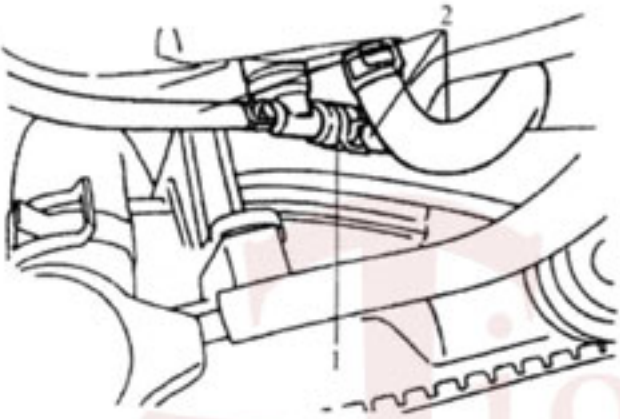


Fig. 10-13 Disassembly of heating hose

1-clamp; 2-hose



Fig. 10-14 Disassembly of plug connector

1-blower motor; 2-resistor; 3-plug connector

2) Disconnect the plug connector of blower motor and resistor (Fig. 10-14);

3) Remove resistor of blower motor of heater (Fig. 10-15);

4) Remove heater inlet pipe and then remove heating device from the vehicle (Fig. 10-16);

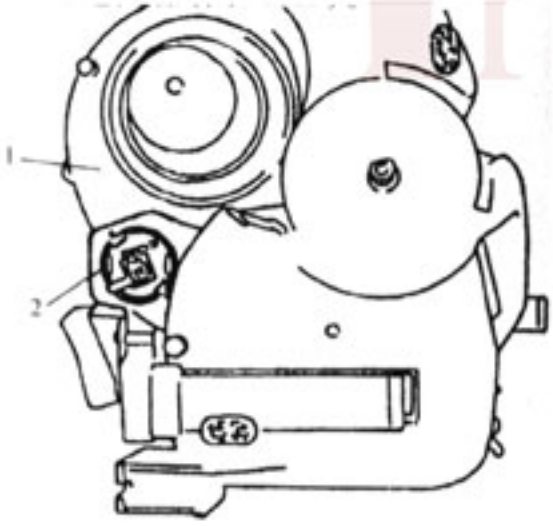


Fig. 10-15 Disassembly of resistor

1-heater; 2-resistor

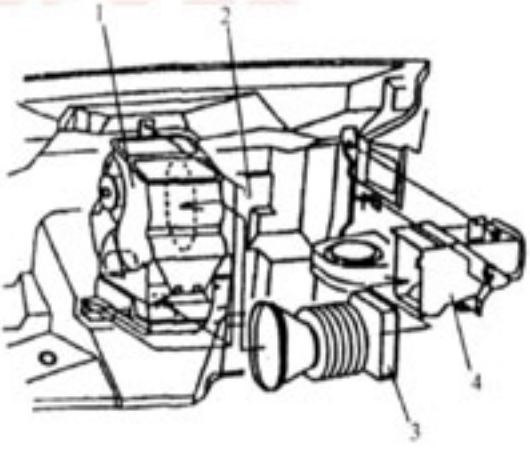


Fig. 10-16 Disassembly of heater

1-heater; 2-nut; 3-heater inlet pipe; 4-inlet box

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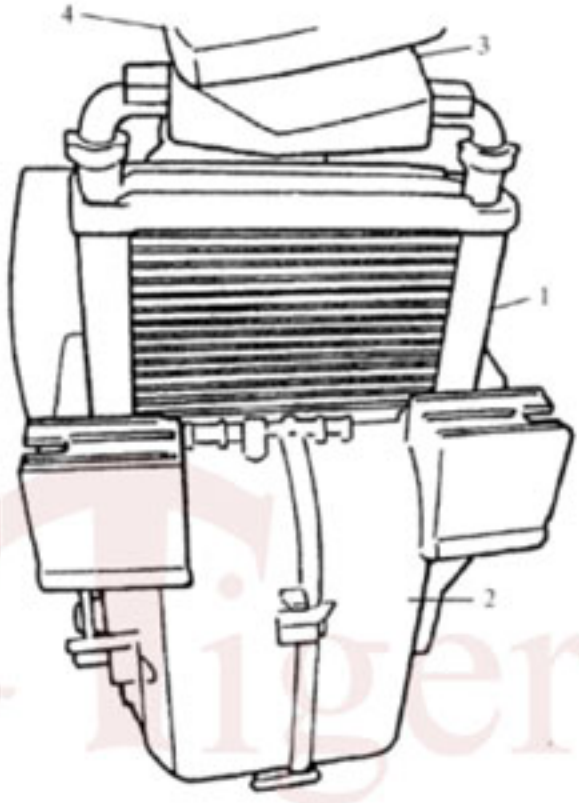


Fig. 10-17 Disassembly of heater core

1-heater core; 2-heater case; 3-support; 4-pad

(1) Repair of heating device

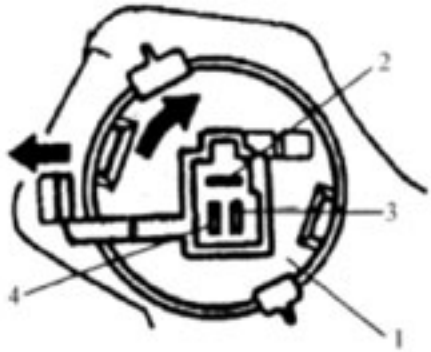
1) Check resistor for crack or damage; if any defect, replace it. Measure resistance between terminals; if the measured value is not correct, replace the resistor (Fig. 10-18);

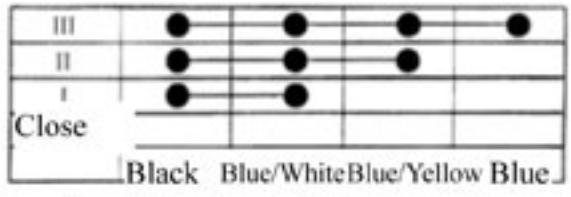
Resistances between terminals: H-M 3Ω

H-L 10Ω

M-L 4Ω

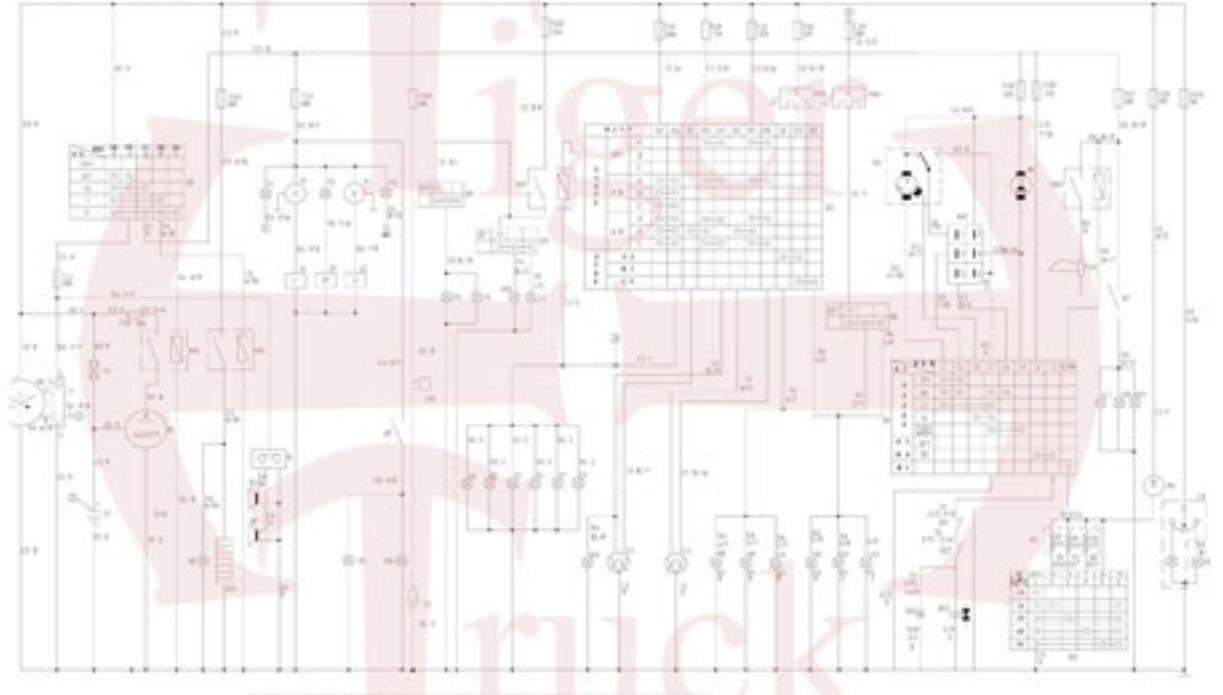
2) Check the continuity condition of blower motor switch circuit using multimeter (Fig. 10-19).





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Annex One: Electrical diagram of KY6 truck



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Annex Two: Electrical diagram of light truck

