TABLE OF CONTENTS

1. GENERAL

Item \ Models	SC1010	SC1010X
ELECTRLCAL		
Ignition timing	10° B. T. D. C. at900r/min(rpm)	←
Standard spark plug	T4196J(4C5T)	←
Starter	Magnetic shift type	←
Generator	Alternator	←
Battery	12V,(36AH)/20hours	←
Headlight	12V,50/40W	←
Turn signal light	12V,20W	←
Clearance light	12V,5W	←
Parking light	12V,5W	←
Tail/Brake light	12V,5/20W	←
Side turn signal light	12V,6W	←
Licence plate light	12V,10W	←
Back up light	12V,10W	←
Room light	12V,5W	←
Meter pilot lights	12V,3.4W	←
Main fuse	30A	←
Fuse box	20A,15A	←
POWER TRANSMISSION		
Clutch type	Dry,single disc	←
Transmission type	4-forward all synchromesh,1 reverse	←
Final reduction ratio	5.143	←
Gear ratios; Low	3.428	←
2nd	2.108	←
3rd	1.379	←
Top	1.000	←
Reverse	3.600	←
WHEEL AND SUSPENSION		
Tire size;Front and rear	4.50-12-8PR	←
Tire pressure — Front	**29Lbs/in²(200kpa)**-when loading under 440lbs	←
Tire pressure — Front	**35cbs/in²(240kpa)**-when loading over 440lbs	←
Tire pressure — Rear	**29Lbs/in²(200kpa)**-when loading under 440lbs	←
Tire pressure — Rear	**54Ibs/in²(375kpa)**-when loading over 440lbs	←
WHEEL AND SUSPENSION		
Suspension type,Front	Strut	←
Rear	Leaf spring	←

Item \ Models	SC1010	SC1010X
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Tire pressure — Rear	**29Lbs/in²(200kpa)**-when loading under 440lbs	←
Tire pressure — Rear	**54Ibs/in²(375kpa)**-when loading over 440lbs	←
WHEEL AND SUSPENSION		
Suspension type,Front	Strut	←
Rear	Leaf spring	←

Item \ Models		SC1010	SC1010X
STEERING			
Turning radius		4.1mm(13.45ft)	←
Steering gear box		Ball-and-nut type	←
Toe-in	Vehicle with 4.50-12-8PR	11～15mm(0.43～0.59in.)	←
Camber angle		1°30′	←
Caster angle		2°30′	←
Trail		11mm(0.43in)	←
King pin angle		12°30′	←
BRAKE SYSTEM			
Type		4-wheel,hydraulic	←
Wheel brake,Front		Two-leading	←
Rear		Leading and trailing	←
Parking brake		Mechanical,2-rear wheels	←
CAPACITIES			
Cooling solution		4.5L	←
Fuel tank		36.0L	←
Engine oil		3.0L	←
Transmission oil		1.0L	←
Differential gear box oil		1.0L	←

1-3. Locations of Engine Number and Body Number

The engine number is punched on the righthand skirt part of the cylinder block under the carburetor.

Fig. 1-4 Location of Engine No.

The body number is punched on the upper surface of the right-hand tire housing located under the seat.

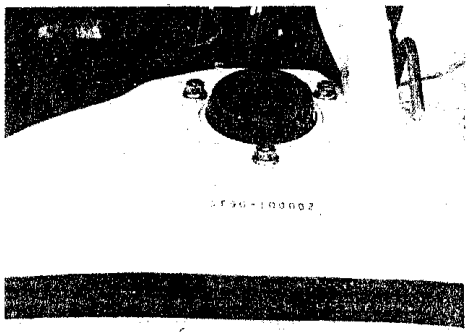


Fig. 1-5 Location of Body No.

1—4. Standard Shop Practices

1. Protect the painted surfaces of the body, and avoid staining or tearing the seats. When working on the fenders and seats, be sure to cover them up with sheets.
2. Disconnect the negative terminal connection of the battery when working on any electrical part or component. This is necessary for avoiding electrical shocks and short-circuiting, and is very simple to accomplish: merely loosen the wing nut on the negative terminal and separate the cable from the terminal post.
3. In raising the front or rear end off the floor by jacking, be sure to put the jack up against the center portion of the axle housing.

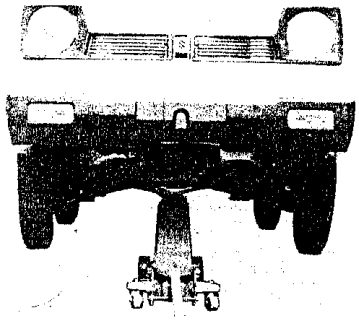


Fig. 1-6

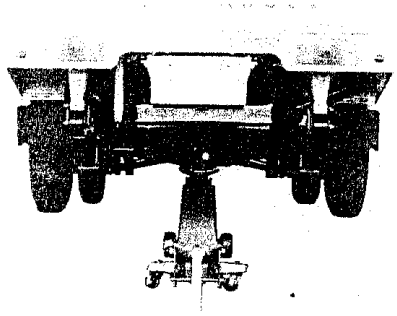


Fig. 1-7

4. To work on the front or rear end raised by jacking, be sure to place the safety stand under the axle to support it in stable condition.

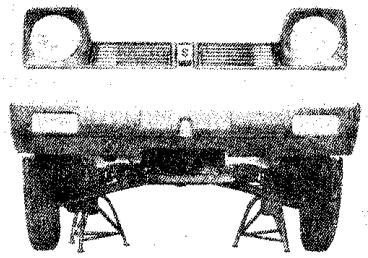


Fig. 1-8

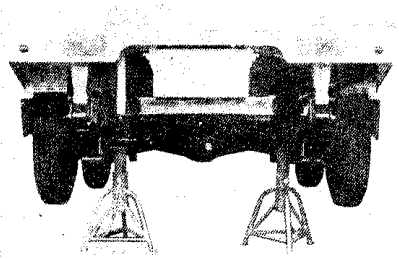


Fig. 1-9

5. Have wheel chocks for ready use in the shop. Chock the wheels securely when raising one end of the machine.
6. Orderliness is a key to successful overhauling. Trays, pans and shelves are needed to set aside the disassembled parts in groups or sets in order to avoid confusion and misplacement. This is particularly important for engine overhauling.
7. Have on hand the liquid packing-ANAEROBIC BOND GY 230, GY 168 for ready use. This packing dope is an essential item assures leak-free (water and oil) workmanship.
8. Each bolt must be put back to where it was taken from or for which it is intended. Do not depend on your hunch in tightening the bolts for which tightening torque values are specified; be sure to use torque wrenches on those bolts.
9. It is advisable to discard and scrap gaskets and "O" rings removed in disassembly. Use new ones in reassembly, and try not to economize gaskets and "O" rings.
10. Special tools save time and ensure good workmanship. Use them where their use is specified. Moreover, your own safety is assured by the use of special tools in many of the disassembly and reassembly steps.
11. Refer to the contents of this MANUAL as often as practical, and do each job right as prescribed.

NOTE:
The engine cylinders are identified by numbers. See Fig. 1-10. Counting from the front end, the cylinders are referred to as No. 1, No. 2, No. 3 and No. 4 cylinders.

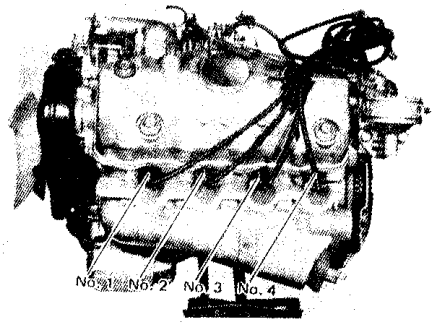
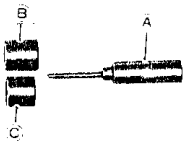
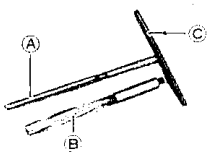
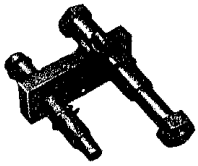
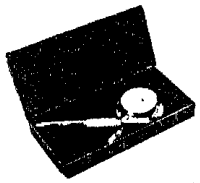
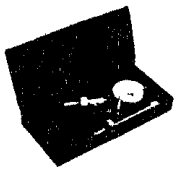
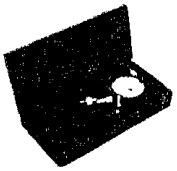
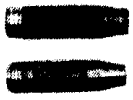
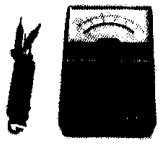
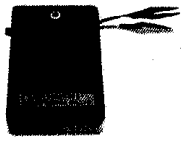
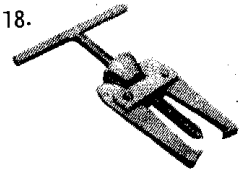
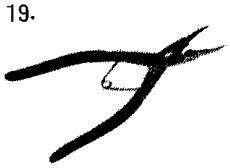
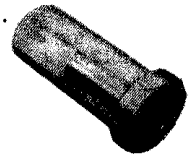
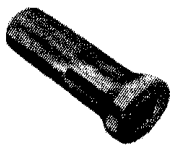
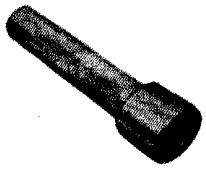
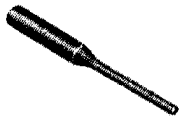


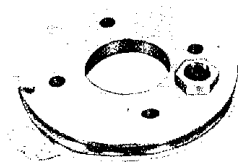
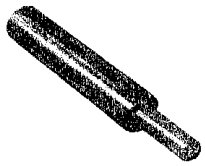
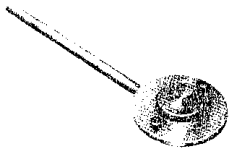
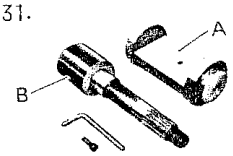
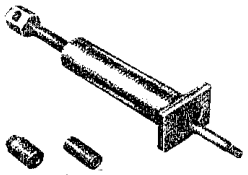
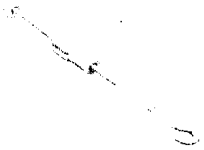
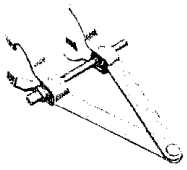
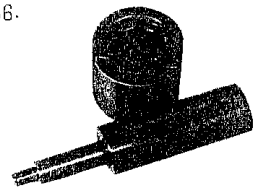
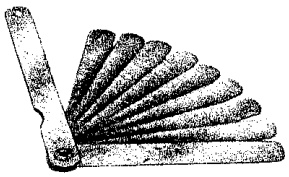
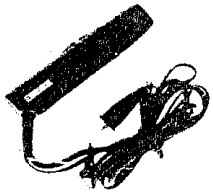
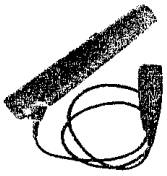
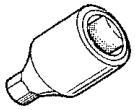
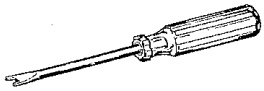
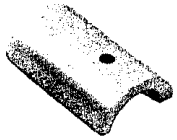
Fig. 1-10 Engine cylinder numbers

1—5. Special Tools

Special tools assure three things; 1)improved workmanship; 2)speedy execution of jobs for which they are meant; and 3)protection of parts and components against damage. Here are the special tools prescribed for the Model SC1010 &SC1010X (not supplied with car).

1.  Valve lifter	2.  (A) Valve guide & valve stem seal handle (B) Valve stem seal installer attachment (C) Valve guide installer attachment	3.  Valve guide remover
4.  Valve guide reamer (A)7mm dia. (B)12. 0mm dia. (C)Handle	5.  Forceps	6.  Flywheel stopper
7.  Oil filter wrench	8.  Piston ring compressor	9.  Oil pressure gauge
10.  Compression gauge	11.  Vacuum gauge	12.  Camshaft lock holder

13.  Shock driver set	14.  Pocket tester	15.  Ignition timing tester
16.  Electro tester	17.  Hexagon wrench 6mm	18.  Bearing puller
19.  Snap ring pliers (closing type)	20.  Snap ring pliers (opening type)	21.  Differential rear outer race installer
22.  Bearing installer	23.  Differential front outer race installer	24.  Differential side bearing installer
25.  Differential side bearing remover jig	26.  Bearing installer	27.  Spring pin remover

28.  Differential pre-load checking tool	29.  Clutch center guide	30.  Differential side bearing adjuster turner
31.  Drive bevel pinion mounting dummy set (A)Body (09924-37720) (B)Attachment(09924-37730)	32.  Piston pin puller	33.  Sliding hammer
34.  Front brake drum remover and Rear axle shaft remover	35.  Coil spring setting tool	36.  Front suspension lower arm bush remover
37.  Thickness gauge	38.  Timing-light(D. C. 12V)	39.  Timing-light(Dry cell type)
40.  Hexagon socket(10mm)	41.  Carburetor adjuster	42.  Clutch shaft bush remover

2. TROUBLE SHOOTING

2-1. Engine

Complaint	Possible causes	Remedy	Page
Poor starting	**Starter will not run**		
	1. Main fuse is bolwn off.	Replace.	
	2. Contact is not closing in starter switch.	Repair or replace.	
	3. Run-down battery.	Recharge.	148
	4. Defective starting relay.	Repair or replace.	
	5. Loose terminal connection on the battery.	Clean and retighten.	150
	6. Defective brushes in starter.	Replace.	134
	7. Loose battery cord connection.	Retighten.	
	8. Open in field or armature circuit of starter.	Repair or replace.	132
	No sparking		
	1. Defective spark plug.	Adjust the gap, or replace.	119/ 120
	2. Short-circuit (grounded) fault in hightension cords.	Repair or replace defective cords.	120
	3. Cracked rotor or cap in distributor.	Replace.	121/
	4. Burnt breaker contact points.	Replace.	123
	5. Breaker contact gap out of adjustment.	Adjust as prescribed.	123
	6. Defective condenser.	Replace.	
	7. Contact is not closing positively in starter switch.	Replace.	121
	8. Loose or blown fuse.	Set right, or replace.	
	9. Ignition timing out of adjustment.	Adjust as prescribed.	123
	10. Defective ignition coil.	Replace.	121
	Faulty intake and exhaust systems		
	1. Carburetor needs readjustment.	Adjust as prescribed.	90
	2. Fuel pump is not discharging adequately.	Replace.	
	3. Clogged air cleaner.	Clean, or replace.	94
	4. Defective choke mechanism.	Repair orreplace.	90
	5. Loose intake manifold.	Retighten	
	6. Caburetor is dirty and clogged.	Disassemble and clean	90
	7. Float level out of adjustment.	Adjust as prescribed.	91
	8. Clogged fuel hose.	Clean or replace.	
	9. Not enough fuel in the tank.	Refill.	
	10. Clogged exhaust ports.	Clean.	

Complaint	Possible causes	Remedy	Page
	Abnormal internal condition in engine		
	1. Ruptured cylinder head gasket.	Replace.	77
	2. Valve clearance out of adjustment.	Adjust as prescribed.	
	3. Weakened or broken valve spring.	Replace.	
	4. Loose manifold, permitting air to be drawn in.	Retighten and, as necessary, replace the gasket.	54
	5. Worn pistons, rings or cylinders.	Replace worn rings and pistons and, as necessary, rebore.	57
	6. Broken valve timing belt.	Replace.	63/73
	7. Poor valve seating.	Repair or replace.	52
	8. Wrong kind of engine oil.	Replace.	84
	9. Burnt valves.	Replace.	
Not enough power	**Inadequate compression**		
	1. Valve clearance out of adjustment.	Adjust as prescribed.	77
	2. Valves not seating tight.	Repair.	52
	3. Valve stems tending to seize.	Replace.	
	4. Broken or weakened valve spring.	Replace.	54
	5. Piston rings seized in grooves, or broken.	Replace.	
	6. Worn pistons, rings or cylinders.	Replace worn parts end, as necessary, rebore.	57
	7. Leaky cylinder head gasket.	Replace.	
	Improperly timed ignition		
	1. Ignition timing out of adjustment.	Adjust as prescribed.	123
	2. Defective spark plug.	Adjust the gap, or replace.	119/120
	3. Breaker point gap out of adjustment.	Adjust or replace.	123
	4. Leaky high-tension cords for some cylinders.	Replace.	
	5. Distributor governor is not working correctly.	Repair.	
	Fuel system out of order		
	1. Clogged carburetor.	Disassemble and clean.	89
	2. Defective fuel pump.	Repair or replace.	
	3. Clogged fuel filter.	Replace.	96
	4. Choke wire working erratically.	Adjust.	
	5. Clogged fuel pipe.	Clean or replace.	90
	6. Clogged fuel tank outlet.	Clean.	
	7. Loose joint in fuel system.	Retighten.	

Complaint	Possible causes	Remedy	Page
	Abnormal condition in air intake system		
	1. Air cleaner dirty and clogged.	Clean or replace.	94
	2. Poor returning motion of choke valve.	Repair, adjust or replace.	90
	Clogged exhaust system		
	1. Muffler is clogged with carbon.	Clean.	
	Overheating tendency of engine		
	1. (Refer to the section entitled "overheating.")		
	Others		
	1. Dragging brakes.	Adjust as prescribed.	231
	2. Slipping clutch.	Adjust or replace.	153/155
Sudden drop of speed in hign-speed cruise	**Abnormal condition in electrical systems**		
	1. Breaker contact point gap too large.	Adjust as prescribed.	123
	2. Spark plug gap too large.	Adjust as prescribed.	120
	3. Cracked rotor or cap in distributor resulting in leakage.	Replace.	120
	4. Defective condenser.	Replace.	121
	5. Deteriorated ignition coil, or crack resulting in leakage.	Replace.	121
	6. Leaky high-tension cords.	Replace.	
	7. Ignition timing out of adjustment.	Adjust as prescribed.	123
	Abnormal condition in fuel system		
	1. Float level set too low.	Adjust as prescribed.	91
	2. Clogged condition of main jet circuit in carburetor.	Clean.	90
	3. Inadequately discharging fuel pump.	Replace.	96
	Abnormal condition in engine		
	1. Loss of compression pressure due to leaky cylinder head gasket.	Replace.	
	2. Compression pressure too low because of worn pistons, rings, cylinders or burnt valves.	Replace and, as necessary, rebore.	13
Engine not responding quickly to pedal control in picking up speed	**Abno rmal condition in electrical system**		
	1. Ignition timing out of adjustment.	Adjust as prescribed.	123
	2. Defective spark plug, or plug gap out of adjustment.	Replace, or adjust as prescribed.	119/120
	3. Leaky high-tension cords for some cylinders.	Replace.	120/123
	4. Breaker contact points out of adjustment or defective.	Adjust or replace.	

Complaint	Possible causes	Remedy	Page
	5. Defective condenser.	Replace.	121
	Abnormal condition in fuel system		
	1. Float level too low or too high.	Adjust as prescribed.	91
	2. Clogged jets in carburetor.	Clean.	90
	3. Air cleaner is dirty and clogged.	Clean or replace.	94
	Abnormal condition in engine		
	1. Exhaust ports dirty with carbon.	Clean.	
	2. Muffler clogged with carbon.	Clean.	13
	3. Compression pressure too low.	Replace worn running parts, or rebore.	52
	4. Poorly seating valves.	Repair.	77
	5. Valve clearance out of adjustment.	Adjust as prescribed.	
	6. Pistons tending to seize.	Replace and, as necessary, rebore.	57
	7. Bearings tending to seize.	Replace.	
Erratic idling	**Abnormal condition in ignition system**		
	1. Ignition timing out of adjustment.	Adjust as prescribed.	123
	2. Defective spark plug, or plug gap too large.	Replace, or adjust.	119/ 120
	3. Cracked cap in distributor, there being leakage inside.	Replace.	120
	4. Leaky high-tension cords.	Replace.	
	5. Cracked rotor in distributor, there being leakage inside.	Replace.	
	Abnormal condition in fuel system		
	1. Carburetor idling adjustment is disturbed.	Adjust as prescribed.	91
	2. Clogged pilot jet in carburetor.	Clean.	90
	3. Air cleaner is dirty and clogged.	Clean or replace.	94
	4. Air is being sucked in due to loose joints or broken parts.	Retighten, or replace.	
	5. Broken carburetor packing.	Replace.	
	Abnormal condition in engine.		
	1. Exhaust ports clogged with carbon.	Clean.	
	2. Valve clearance out of adjustment.	Adjust as prescribed.	77
	3. Poorly seating valves.	Repair.	52
	4. Blown cylinder head gasket.	Replace.	

Complaint	Possible causes	Remedy	Page
Abnormal detonation	**Abnormal condition in ignition system**		
	1. Spark plugs are tending to overheat.	Change plug heat value.	119
	2. Ignition timing out of adjustment.	Adjust as prescribed.	123
	3. Defective breaker contact points.	Replace.	120/123
	4. Loose connection in high-tension or low-tension circuit.	Retighen.	90
	Abnormal condition in fuel system		
	1. Air-fuel mixture too lean.	Clean and adjust.	90
	2. Carburetor is dirty inside.	Clean	
	3. Water inside carburetor.	Clean.	
	4. Air is leaking in through inlet manifold joint.	Retighten.	
	Abnormal condition in engine		
	1. Excessive carbon deposit on piston crowns or cylinder head.	Clean.	47
	2. Blown cylinder head gasket, resulting in low compression pressure.	Replace.	
	3. Valve clearance out of adjustment.	Adjust as prescribed.	77
	4. Valves tending to seize.	Replace.	
	5. Weakened valve springs.	Replace.	54
Overheating	**Abnormal condition in ignition system**		
	1. Ignition timing out of adjustment.	Adjust as prescribed.	123
	2. Wrong heat value of spark plugs.	Change heat value.	119/120
	3. Breaker point gap out of adujstment in distributor.	Adjust as prescribed.	123
	Abnormal condition in fuel and exhaust systems		
	1. Float level set too low.	Adjust as prescribed.	91
	2. Clogged jets in carburetor.	Clean.	90
	3. Loose inlet manifold.	Retighten.	
	4. Clogged exhaust ports.	Clean.	
	Abnormal condition in cooling system		
	1. Not enough coolant.	Refill.	108
	2. Loose or broken fan belt.	Adjust or replace.	106
	3. Erratically working thermostat.	Replace.	106
	4. Poor water pump performance.	Replace.	
	5. Leaky radiator.	Repair or replace.	

Complaint	Possible causes	Remedy	Page
	Abnormal condition in lubrication system		
	1. Clogged oil filter.	Replace.	83
	2. Clogged oil strainer.	Clean.	
	3. Deteriorated oil pump performance	Replace.	83
	4. Oil leakage from oil pan or pump.	Repair.	
	5. Wrong kind of lubrication oil.	Change.	84
	6. Not enough oil in oil pan.	Replenish.	84
	Others		
	1. Dragging brakes.	Adjust.	231
	2. Slipping clutch.	Adjust or replace.	153
	3. Blown cylinder head gasket.	Replace.	
Abnormal engine noise	**Crankshaft noise**		
	1. Worn-down bearings, resulting in excessively large running clearances.	Replace.	60/62
	2. Worn connecting-rod bearings.	Replace.	59/68
	3. Distorted connecting rods.	Repair or replace.	59
	4. Worn crankshaft journels.	Repair by grinding, or replace crankshaft.	61/62
	5. Worn crankpins.	Repair by grinding, or replace crankshaft.	60
	Noise due to pistons, rings, pins or cylinders		
	1. Abnormally worn bores of cylinders.	Rebore to next oversize or replace.	56
	2. Worn pistons, rings or pins.	Replace and, as necessary, rebore to next oversize.	56/58
	3. Pistons tending to seize.	Replace.	
	4. Broken piston rings.	Replace.	
	Others		
	1. Excessively large camshaft thrust play.	Replace.	55
	2. Excessively large crankshaft thrust clearance.	Adjust as prescribed.	61
	3. Valve clearance too large.	Adjust as prescribed.	77
	4. Not enough engine oil.	Replenish.	84
High fuel consumption	**Abnormal condition in ignition system**		
	1. Ignition timing out of adjustment.	Adjust as prescribed.	123
	2. Leaky high-tension cords.	Replace.	123
	3. Breaker point gap maladjusted.	Adjust or replace.	119/120
	4. Wrong heat value of spark plugs.	Change heat value.	
	5. Cracked distributor cap or rotor.	Replace.	120

Complaint	Possible causes	Remedy	Page
	Abnormal condition in fuel system		
	1. Fuel leakage from tank, pipe or carburetor.	Repair or replace.	
	2. Erratic returning action of choke valve.	Repair and adjust.	92
	3. Pilot screw set incorrectly.	Adjust as prescribed.	91
	4. Clogged breather in carburetor.	Clean.	
	5. Air cleaner is dirty and clogged.	Clean or replace.	94
	Abnormal condition in engine		
	1. Leakage of combustion gases from cylinder head.	Retighten, or replace head gasket.	
	2. Valve seating poorly.	Repair.	52
	3. Valve clearance out of adjustment.	Adjust as prescribed.	77
	Others		
	1. Dragging brakes.	Adjust as prescribed.	231
	2. Slipping clutch.	Adjust or replace.	153
Excessive engine oil consumption	**Oil leakage**		
	1. Oil drain plugs loose.	Retighten.	
	2. Loose oil pan securing bolts.	Retighten.	
	3. Broken oil pan gasket.	Replace.	
	4. Leaky oil seals.	Replace.	
	5. Blown cylinder head gasket.	Replace.	
	6. Oil filter malpositioned or loose.	Set the pump right, or retighten mounting bolts.	
	"Oil pumping" (Oil finding its way into combustion chambers.)		
	1. Oil rings are worn or broken.	Replace.	58
	2. Piston ring end gaps are not staggered as prescribed.	Reposition rings.	66
	3. Badly worn ring grooves.	Replace pistons.	58
	4. Worn pistons or cylinders.	Replace pistons and, as necessary, rebore.	56
	Oil leakage along valve stems		
	1. Defective valve stem oil seals.	Replace.	
	2. Badly worn valves or valve guide bushes.	Replace.	49/50

2-2. Carburetor

Complaint	Possible causes	Remedy	Page
Fuel overflow from carburetor	1. Float valve is worn or dirty with foreign matter.	Clean or replace.	90
	2. Float is ruptured and contains some fuel.	Replace.	
	3. Broken or otherwise defective gasket.	Replace.	
	4. Loose float chamber securing screws.	Retighten.	
	5. Fuel pump discharge pressure too high.	Adjust.	

2-3. Exhaust and Muffler

Complaint	Possible causes	Remedy	Page
Poor muffling performance	1. Loose exhaust pipe connection.	Retighten.	
	2. Broken muffler gasket.	Replace.	
	3. Broken manifold, pipe or muffler.	Repair or replace.	
	4. Exhaust manifold loose in place.	Retighten.	
	5. Interference between body and muffler.	Repair, eliminating any contact.	

2-4. Clutch

Complaint	Possible causes	Remedy	Page
Slipping clutch	1. Loss of clearance at the tip of release fork.	Adjust as prescribed.	155
	2. Clutch facings dirty with oil.	Replace.	
	3. Clutch facings excessively worn.	Replace.	153
	4. Weakened diaphragm spring.	Replace.	
	5. Distorted pressure plate or flywheel surface.	Replace.	64
	6. Play of clutch pedal.	Adjust and, as necessary, replace clutch facings.	153/ 155
Dragging clutch	1. Excessive clutch pedal play.	Adjust as prescribed.	155
	2. Weakened diaphragm spring, or worn spring tip.	Replace.	
	3. Damaged or worn splines of transmission input shaft.	Replace.	
	4. Front input shaft bearing worn or broken.	Replace.	154
	5. Excessively wobbly clutch disc.	Replace.	
	6. Clutch facings broken or dirty with oil.	Replace.	

Complaint	Possible causes	Remedy	Page
Clutch vibration	1. Glazed (glass-like)clutch facings.	Repair or replace.	
	2. Clutch facings dirty with oil.	Replace.	
	3. Wobbly clutch disc,or poor facing contact.	Replace.	
	4. Weakened torsion springs(in clutch disc).	Replace.	
	5. Clutch disc rivets loose.	Replace the disc.	
	6. Distorted pressure plate or flywheel surface.	Replace.	63
	7. Weakened engine mounts(cushion pads).	Retighten or replace.	
Noisy clutch	1. Worn or broken release(throw-out)bearing.	Replace.	154
	2. Front input shaft bearing worn down.	Replace.	154
	3. Excessive rattle of clutch disc hub.	Replace the disc.	154
	4. Cracked clutch disc.	Replace.	
	5. Pressure plate and diaphragm spring are rattling.	Replace.	
Grabbing clutch	1. Clutch facings are soaked with oil.	Replace.	
	2. Clutch facings are excessively worn.	Replace.	153
	3. Rivet heads are showing out of the facing.	Replace.	153
	4. Torsion springs are weakened.	Replace.	

2—5. Transmission

Complaint	Possible causes	Remedy	Page
Gears slipping out of mesh	1. Distorted shift rod.	Repair or replace.	
	2. Worn shift fork shaft.	Replace.	
	3. Worn locating steel balls.	Replace.	178
	4. Weakened springs for locating steel balls.	Replace.	
	5. Worn shift fork.	Replace.	
	6. Excessive rattle in thrust direction of gears.	Replace.	177
	7. Worn ring of hub in synchronizers.	Replace.	
	8. Worn bearings of input shaft,main shaft or countershaft.	Replace.	176
Gears refusing to disengage	1. Weakened or broken synchronizer springs.	Replace.	
	2. Worn inner groove of synchronizer ring.	Replace.	177
	3. Synchronizer ring is seized on the cone.	Replace the ring.	
	4. Distorted shift fork shaft or shift fork.	Replace.	
	5. Worn shift fork.	Replace.	
Excessive gear noise	1. Not enough oil in transmission.	Replenish.	182
	2. Defective synchronizer.	Replace.	
	3. Gears rattling in thrust direction.	Replace.	
	4. Broken or worn bearings.	Replace.	177

Complaint	Possible causes	Remedy	Page
Hard shifting	1. Clutch pedal play too large, resulting in a "dragging clutch."	Adjust as prescribed.	155
	2. Clutch disc facings are worn.	Replace.	153
	3. Clutch disc facings are dirty with oil.	Replace.	
	4. Distorted or unevenly worn shift fork shaft.	Replace.	
	5. Broken locating balls.	Replace.	
	6. Worn synchronizer sleeve.	Replace.	177
	7. Worn synchronizer hub.	Replace.	

2-6. Differential

Complaint	Possible causes	Remedy	Page
Breakage (case, gears, bearings, etc.)	1. Insufficient or wrong kind of gear oil.	Replenish or change.	197
	2. Improperly shimmed side bearings or pinion bearings.	Adjust as prescribed.	193
	3. Improper mesh of drive pinion with ring gear.	Adjust or replace.	191/195
	4. Excessive backlash due to worn side gear thrust washer and pinion thrust washer.	Adjust or replace.	190
	5. Distorted rear axle housing.	Replace.	
	6. Loose bolts securing ring gear.	Replace.	
Gear noise	1. Maladjusted backlash between drive pinion and ring gear.	Adjust as prescribed.	191/193
	2. Damaged gear teeth or improper mesh of drive pinion and ring gear.	Replace or adjust.	191/195
	3. Improper tooth contact in the mesh between drive pinion and ring gear.	Adjust as prescribed.	195
	4. Insufficient or wrong kind of gear oil.	Replenish or replace.	
	5. Ring gear wobbles when turning, or ring gear securing bolts are loose.	Replace, or retighten.	197
	6. Broken or otherwise damaged teeth of side gears or differential pinion gears.	Replace.	
Bearing noise	1. (Constant noise) Insufficient or wrong kind of gear oil.	Replenish or change.	197
	2. (Constant noise) Damaged or worn bearings or borne parts.	Replace.	
	3. (Noise during coasting) Damaged bearings of-rear drive pinion.	Replace.	

2-7. Propeller Shaft

Complaint	Possible causes	Remedy	Page
Vibration and noise	1. Broken or worn bearings of universal joint spider.	Replace.	
	2. Distorted propeller shaft.	Replace.	
	3. Unbalanced propeller shaft.	Replace.	
	4. Loose propeller shaft.	Retighten.	
Noise occurring at standing start or during coasting	1. Worn or damaged universal joint.	Replace.	
	2. Worn propeller shaft splines, due to lack of lubrication.	Replace.	
	3. Loose propeller shaft.	Retighten.	
	4. Loose flanged yoke of universal joint.	Retighten.	

2-8. Brakes

Complaint	Possible causes	Remedy	Page
Not enough braking force	1. Brake oil leakage from brake lines.	Locate the leaking point and repair.	
	2. Drum-to-shoe clearance out of adjustment.	Adjust as prescribed.	
	3. Overheated brakes.	Determine the cause or overheating, and repair	231
	4. Poor contact of shoes on brake drum.	Adjust for proper contact.	
	5. Brake shoes stained with oil or wet with water.	Replace.	230
	6. Badly worn brake shoe linings.	Replace.	230
Uneven braking (Brakes not working in unison.)	1. Shoe linings are wet with water or stained with oil in some brakes.	Clean or replace.	230
	2. Drum-to-shoe clearance out of adjustment in some brakes.	Adjust as prescribed	231
	3. Drum is out of round in some brakes.	Replace.	229
	4. Wheel tires are inflated unequally.	Inflate equally.	214
	5. Defective wheel cylinders.	Repair or replace.	
	6. Disturbed front wheel alignment.	Adjust as prescribed.	219

Complaint	Possible causes	Remedy	Page
Pedal stroke too large	1. Drum-to-shoe clearance out of adjustment.	Adjust as prescribed.	231
	2. Air trapped in the brake oil circuit.	Bleed air out as prescribed.	230
	3. Brake oil leakage.	Locate the leaking point and repair.	
	4. Not enough oil in the brake fluid reservoir.	Replenish.	
	5. Excessively worn brake drums.	Replace.	229/230
	6. Distorted or poorly contacting brake shoes.	Repair or replace.	230
	7. Defective cup in master cylinder.	Replace.	
	8. Worn brake shoes.	Replace.	230
Dragging brake	1. Clogged return port in master cylinder.	Clean.	
	2. Brake shoes improperly mounted on backing plate.	Repair.	
	3. Weakened or broken return springs in the brake.	Replace.	
	4. Defective wheel cylinders.	Repair or replace.	
	5. Sluggish parking-brake cables or linkage.	Repair or replaces.	
	6. Brake shoes improperly adjusted.	Adjust as prescribed.	231
Pedal pulsation (Pedal pulsates when depressed for braking.)	1. Damaged or out-or-round brake drums.	Replace.	229
	2. Damaged wheel bearings.	Replace.	
	3. Distorted steering knuckle or rear axle shafts.	Replace.	
Braking noise	1. Glazed shoe linings, or foreign matters stuck to linings.	Repair or replace.	230
	2. Worn or loose shoe linings.	Replace.	
	3. Broken front wheel bearings.	Replace.	230
	4. Distorted or loose backing plates.	Replace, or retighten securing bolts.	

2-9. Front Suspension and Steering System

Complaint	Possible causes	Remedy	Page
Hard steering	1. Wheel tires not adequately inflated.	Adjust the pressure.	214
	2. Tie rod ends tending to seize.	Replace.	
	3. Linkage connections tending to seize.	Repair or replace.	
	4. Steering gearbox out of adjustment.	Adjust as prescribed.	213
	5. Unevenly worn steering shaft bush.	Replace.	
	6. Poorly lubricated or worn joints in linkage.	Lubricate or replace.	
	7. Disturbed front wheel alignment.	Adjust as prescribed.	219
Wobbly steering wheel	1. Wheel tires inflated unequally.	Adjust the pressure.	
	2. Wobbly wheels.	Repair or replace.	
	3. Large difference in tire diameter between right and left wheels.	Replace.	
	4. Loose hub nuts.	Retighten.	214
	5. Damaged or worn wheel bearings.	Replace.	
	6. Worn or loose tie rod ends.	Replace or retighten.	
	7. Steering gearbox out of adjustment.	Adjust as prescribed.	213
	8. Steering gearbox mounted loose.	Retighten.	
	9. Worn steering center lever.	Replace.	
Steering wheel pulling to one side	1. Unevenly worn wheel tires.	Replace.	
	2. Brake dragging in one road wheel.	Repair.	231
	3. Wheel tires unequally inflated.	Adjust the pressure.	214
	4. Worn or distorted link rods.	Replace.	
	5. Disturbed front wheel alignment.	Adjust as prescribed.	219
Shocks coming to steering wheel	1. Tire inflating pressure too high.	Reduce to the specification.	214
	2. Poor shock absorber performance.	Replace.	
	3. Differences in tire diameter among the four-road wheels.	Adjust.	
	4. Worn steering linkage connections.	Replace.	
	5. Worn or broken front wheel bearings.	Replace.	
	6. Loose front wheel.	Retighten.	
	7. Steering wheel loose in place.	Retighten the nut.	214
Rapid wear or uneven wear of wheel tires	1. Wheel tires improperly inflated.	Adjust the pressure.	214
	2. Differences in diameter among the four tires.	Adjust or replace.	
	3. Worn or loose road wheel bearings.	Repalce.	
	4. Wobbly wheel tires.	Repair or replace.	
	5. Wheel tires improperly "rotated" to result in unbalance.	Adjust.	215
	6. Disturbed front wheel alignment.	Adjust as prescribed.	219

Complaint	Possible causes	Remedy	Page
Steering noise	1. Loose bolts and nuts.	Retighten.	
	2. Loose leaf spring seats.	Retighten.	
	3. Broken or otherwise damaged wheel bearings.	Replace.	
	4. Worn or sticky tie rod ends.	Replace.	
	5. Linkage joints needing grease.	Lubricate or replace.	

2-10. Starting Motor

Complaint	Possible causes	Remedy	Page
Starter runs but pinion will not mesh into ring gear.	1. Worn pinion of starter clutch.	Replace.	
	2. Defective splines, resulting in sticky pinion plunging motion.	Repair or replace.	
	3. Worn bush.	Replace.	
	4. Wrong pinion plunging position.	Adjust.	
	5. Worn teeth of ring gear.	Replace.	
Starter will not run at all, or runs but runs too slow to crank with full force.	**Battery trouble**		
	1. Poor contact in battery terminal connection.	Repair or retighten.	
	2. Loose grounding cable connection.	Retighten.	149/150
	3. Battery run down.	Recharge.	149/150
	4. Battery voltage too low due to battery deterioration.	Replace.	
	Ignition switch trouble		
	1. Poor contacting action.	Replace.	
	2. Lead wire socket loose in place.	Retighten.	
	3. Open-circuit between ignition switch and magnet switch.	Repair.	
	Magnet switch trouble		
	1. Lead wire socket loose in place.	Retighten.	
	2. Burnt contact plate, or poor contacting action.	Replace, or repair.	
	3. Open-circuit in pull-in coil.	Replace.	
	4. Open-circuit in holding coil.	Replace.	
	Starter proper trouble		
	1. Brushes are seating poorly or worn down.	Repair or replace.	134
	2. Burnt commutator.	Repair or replace.	132/133
	3. Open-circuit in armature winding.	Replace.	132/133
	4. Worn-down starter.	Replace.	

Complaint	Possible causes	Remedy	Page
Starter does not stop running.	1. Fused contact points of magnet-switch contact plate.	Repair or replace.	
	2. Short-circuit between turns of magnet-switch coil(layer short-circuit).	Replace.	
	3. Failure of returning action in ignition switch.	Replace.	

2-11. Alternator

Complaint	Possible causes	Remedy	Page
Battery quickly becomes overdischarged.	1. Loose or broken "V" belt.	Adjust or replace.	106
	2. Open-circuit in stator winding.	Repair or replace.	144
	3. Open-circuit in rotor winding.	Repair or replace.	143
	4. Excessively worn slip ring brushes.	Replace.	144
	5. Weakened brush springs.	Replace.	
	6. Regulator setting too low. (Regulated voltage too low.)	Adjust as prescribed.	145
	7. Poor contacting action of low-speed point in regulator.	Repair.	145
	8. Fused high-speed contact point in regulator.	Repair, or replace.	
	9. Improper acid concentration in or low level of battery electrolyte.	Replace, or replenish.	148
	10. Defective battery cell plates.	Replace the battery.	
	11. Insufficient contact in battery terminal connection.	Clean and retighten.	149/150
	12. Open-circuit between two "F" terminals (one on regulator and the other on alternator), or high resistance.	Repair.	140
	13. Excessive electrical load.	Advise the user to economize.	
Battery tends to become overcharged.	1. Regulated voltage set too high.	Adjust as prescribed.	145
	2. Poorly grounded "E" terminal of regulator.	Repair.	
	3. Open-circuit in voltage-regulator pressure coil.	Replace.	140
	4. Fused low-speed point of regulator.	Repair or replace.	
	5. Poor contacting action of high-speed point of regulator.	Repair or replace.	
	6. Open-circuit or high resistance between two "N" terminals (one on alternator and theother on regulator).	Repair.	
Alternator noise	1. Worn, loose or otherwise defective bearings.	Replace.	

2-12. Wiper Motor

Complaint	Possible causes	Remedy	Page
Wiper will not run.	1. Fuse is set loose or blown off. 2. Incomplete metal-to-metal contact in connector. 3. Worn or floating brushes. 4. Dirty or burnt commutator. 5. Short-circuited or fused field coil. 6. Loose terminal connection on wiper switch.	Tighten or replaces. Repair. Replace or repair. Repair or replace. Replace. Repair.	
Wiper will not stop running.	1. Defective wiper switch.	Replace or repair.	
Wiper stops at wrong position.	1. Improper wiper arm setting. 2. Cover plate incorrectly positioned in place.	Repair. Repair.	
Poor wiping action.	1. Insufficient pressure of wiper arm. 2. Deteriorated or hardened blade. 3. Blade improperly set. 4. Windshield dirty with oil.	Replace. Replace. Repair or replace. Clean.	

2-13. Fuel Meter

Complaint	Possible causes	Remedy	Page
Faulty meter indication	1. Incomplete metal-to-metal contact in terminal connections. 2. Defective receiver gauge due to burnt point or deformed bimetal element. 3. Erratic float movement. 4. Defective grounding(for float and gauge).	Retighten. Replace. Repair or replace. Repair.	
No indication	1. Open-circuit. 2. Open-circuited heat wire. 3. Burnt point. 4. Deformed bimetal element. 5. Open-circuited resistor.	Repair. Replace. Replace. Replace. Replace.	259

2-14. Turn Signal Lights

Complaint	Possible causes	Remedy	Page
Flashing frequency is higher on one side, or flashing occurs only on one side, right or left.	1. Lights are imperfectly grounded. 2. Lights of wrong watt ratings are used. 3. One of the light bulbs is blown on right or left side or on front or rear side. 4. Defective turn signal relay. 5. Open-circuit or high resistance between switch and lights.	Repair. Replace. Replace. Replace. Repair.	
No flashing on occurs on both sides, right and left.	1. Blown fuse in turn signal circuit. 2. Open-circuit or high resistance between battery and switch. 3. Defective turn signal relay.	Replace. Repair. Replace.	
Flashing frequency is too low, or no flashing occurs on both sides.	1. Lights of a smaller watt rating than the specification rating are used. 2. One of the lights on right or left side or on front or rear side is poorly grounded. 3. Supply voltage is too low. 4. Fuse set loose in place, resulting in poor contact. 5. Incomplete metal-to-metal contact in connector. 6. Defective turn signal relay.	Replace. Repair. Recharge the battery. Repair or replace. Repair. Replace.	149/150
Flashing frequency is too high.	1. Lights of a larger wattage than the specification are used. 2. Defective flasher.	Replace. Replace.	

2-15. Speedometer

Complaint	Possible causes	Remedy	Page
Faulty indication	1. Damaged speedometer drive or driven gear. 2. Defective drive cable. 3. Drive cable incompletely or improperly tied into the meter. 4. Defective speedometer.	Replace. Replace. Set right. Replace.	
Speedometer noise	1. Inadequately lubricated or defective cable. 2. Not enough oil in transmission.	Lubricate or replace. Replenish.	182

2—16. Water Temperature Meter

Complaint	Possible causes	Remedy	Page
Faulty indication	1. Incomplete metal-to-metal contact in terminal connections. 2. Receiver gauge defective (due to burnt point or deformed bimetal element). 3. Defective temperature gauge.	Repair and tighten. Replace. Replace.	
No indication	1. Open-circuit. 2. Defective receiver gauge (open-circuited heat wire, deformed bimetal element or pointer). 3. Defective temperature gauge.	Repair Replace. Replace.	105

2-17. Oil Pressure Warning Light

Complaint	Possible causes	Remedy	Page
Turning ignition switch on (for engine starting) does not light this light.	1. Light bulb is blown. 2. Blown-off fuse. 3. Defective oil pressure switch. 4. Open-circuit between light and ignition switch. 5. Open-circuit between light and pressure switch.	Replace. Replace. Replace. Repair. Repair.	
Light remains burning even after engine starts up.	1. Not enough oil in engine oil pan. 2. Oil pressure too low. 3. Defective oil pressure switch.	Replenish. Repair or replace the pump. Replace.	84 83

2-18. Charge Warning Light

Complaint	Possible causes	Remedy	Page
Turning ignition switch on does not light this light.	1. Light bulb is blown. 2. Blown-off fuse. 3. Open-circuit. 4. High resistance in circuit wire due to loose connection.	Replace. Replace. Replace. Retighten.	
Light remains burning even after engine starts up.	1. Alternator is not producing full output. 2. Defective voltage regulator. 3. Ground-circuit formed between light and the battery.	Repair Repair or replace. Repair.	26 145

2-19. Horn

Complaint	Possible causes	Remedy	Page
Horn will not sound off.	1. Blown-off fuse. 2. Broken circuit wire. 3. Defective horn.	Replace. Repair. Replace.	
Poor sound quality	1. Incomplete contacting action inside horn switch. 2. Improper point gap or burnt point inside the horn. 3. Cracked diaphragm.	Repair. Repair or replace. Replace.	

3. ENGINE

3-1 . Description

1) **The engine is a water-cooled, in-line 4 cylinders, 4-stroke cycle gasoline unit with its S. O. H. C. (single overhead camshaft) valve mechanism arranged for "V"-type valve configuration.**

The single overhead camshaft (S. O. H. C.) is mounted over the cylinder head; it is driven from crankshaft through timing belt. Unlike conventional overhead valve (O. H. V.) engine, this engine has no pushrods. Thus, drive for valves is more direct and enables the valves to follow the crankshaft without any delay.

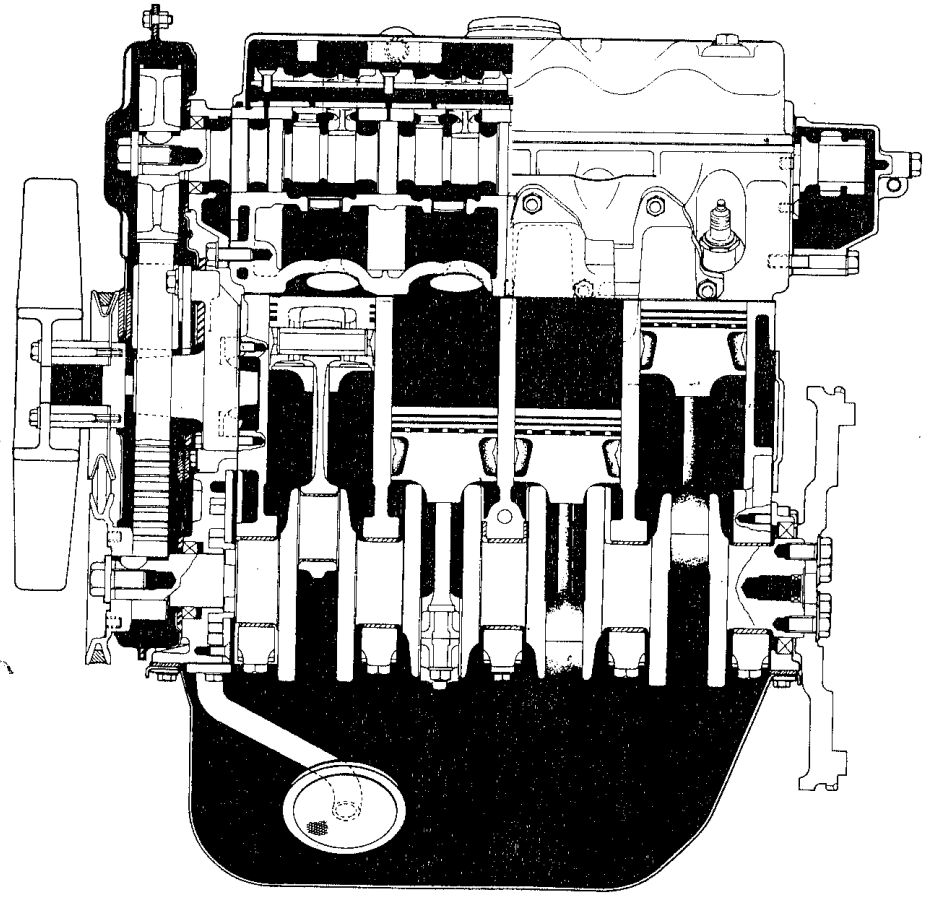


Fig. 3-1

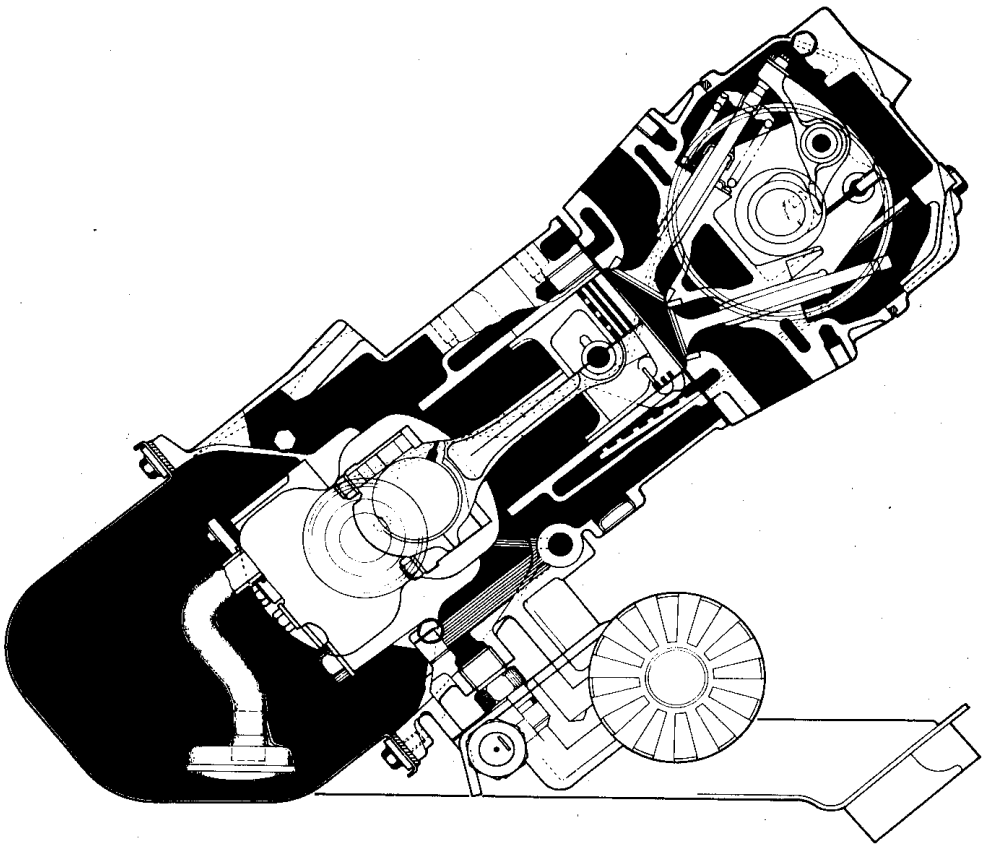


Fig. 3-1-1

2)The distinctive features of this engine may be summarized as follows:

1. Because of inlet and exhaust ports arranged for cross-flow pattern, with valves located in "V"-type configuration, both volumetric and scavenging efficiencies are very high.

2. The combustion chamber formed between piston crown and cylinder head is of a multi-spherical type shaped to provide squish. This feature is calculated to make available greater horsepower from a lesser amount of fuel.

3. The supports for camshaft and rocker shafts are integral with the cylinder head, so that the valve mechanism noise is markedly reduced by the structural rigidity and, moreover, that the number of valve mechanism parts is reduced, let alone a more compact size of the engine.

4. The timing belt for driving the camshaft runs quiet and is light in weight.

5. A high-grade cast iron is used for the material of the cylinder block. The block is shaped to present deep skirts and retain greater rigidity.

6. The crankshaft is a one-piece forging, and is supported by five bearings for vibration-free running.

7. Heating by hot water is employed for the inlet manifold in order to facilitate fuel carburetion and ensure that uniform distribution of the mixture. The higher combustion efficiency of this engine is largely explained by this inlet manifold feature.

3) Blowby gas recycling system

Blowby gas passage is provided in the cylinder block to pass the blowby gases from crankcase to cylinder head. In the head cover, an oil separator removes oil particles from the gases before the gases are drawn into the air cleaner.

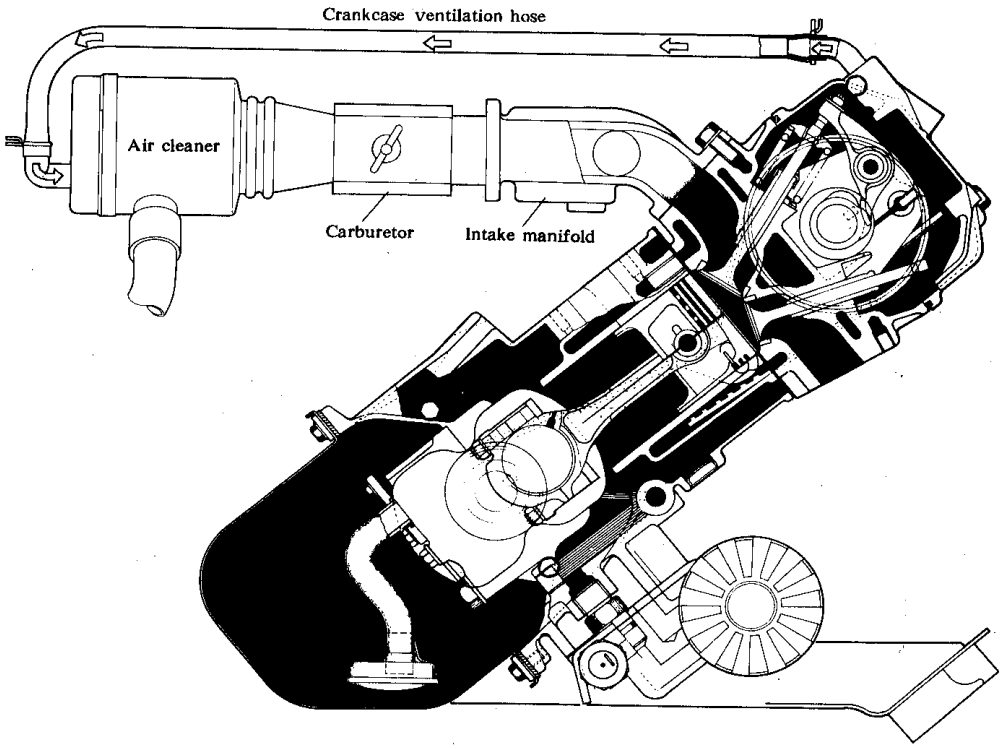


Fig. 3-2

3-2. Engine Services Not Requiring Engine Removal

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

Part or Component	Nature of Service
1. Spark plug	Replacement or inspection
2. Distributor	Replacement, inspection or adjustment
3. Exhaust manifold	Replacement or inspection
4. Oil filter	Replacement
5. Oil pressure sensor unit	Replacement
6. Cylinder head cover	Replacement
7. Rocker shaft	Replacement or inspection
8. Rocker-arm	Replacement or inspection
9. Rocker-arm spring	Replacement or inspection
10. Camshaft (needing cylinder head removal)	Replacement or inspection
11. Cylinder head	Replacement or inspection
12. Radiator	Replacement or inspection
13. Cooling fan	Replacement
14. Camshaft timing belt pulley	Replacement or inspection
15. Cranshaft timing belt pulley	Replacement or inspection
16. Timing belt	Replacement or inspection
17. Fuel pump	Replacement
18. Carburetor	Replacement, inspection or adjustment
19. Intake manifold	Replacement
20. Alternator	Replacement or inspection
21. Starter motor	Replacement or inspection
22. Fan belt	Replacement, inspection or tension adjustment
23. Water pump	Replacement
24. Pulleys (crank, generator, fan)	Replacement
25. Timing belt cover	Replacement
26. Water hose	Replacement or inspection
27. Oil pump, piston, piston ring and connecting rod	Replacement or inspection

3-3 Dismounting the Engine

1. Remove the engine service cover panel on the bed floor.
2. Remove the engine under cover.
3. Loosen two drain plugs, one on the bottom of radiator and one on the cylinder block, to drain the cooling water.
4. Disconnect negative (—) and positive (+) cords from the battery terminals.
5. Disconnect the lead wire from the water temperature gauge.
6. Disconnect the harness coupler from the alternator terminals.
7. Disconnect the primary wire (white/black) from the distributor terminal.
8. Remove the distributor cap and rotor from the distributor.
9. Disconnect the fuel hoses from the fuel pump body.
10. Disconnect the warm air hose (optional). if one is attached.
11. Disconnect the accelator cable from the carburetor body.
12. Disconnect the choke cable from the carburetor body.
13. Take out the crankcase ventilation hose from the cylinder head cover.
14. In case of machine equipped with optional car-heater, disconnect the inlet and outlet heater hoses at the joining part.
15. Disconnect the radiator inlet hose from the thermostat cap.
16. Remove the air cleaner case ass' y.
17. Disconnect the fuel return hose from the carburetor body.
18. Disconnect the radiator outlet hose from the water inlet pipe.
19. Disconnect the lead wire (brown/green) from the oil pressure unit, and remove the lead wire clamps.
20. Disconnect the clutch cable from the engine mounting member and clutch lever.
21. Remove the muffler from the exhaust pipe and then from the chassis.
22. Remove the propeller shaft.
23. Disconnect the speedometer cable from the transmission case (extension case).
24. Disconnect the back up lamp switch lead wire at the coupler.
25. Disconnect the gear shift and select control rods from the joints on the extension case.
26. Disconnect the lead wire (white /brown) and (+) cord from the starter motor.
27. Disconnect the battery ground (—) cord from the transmission case.
28. Remove the radiator lower shroud.
29. Jack up the body placing the jack between the engine and transmission.
30. Remove the transmission mounting bracket from the chassis frame.
31. Remove the engine mounting brackets from the chasssis frame.

> **CAUTION:**
> **Before starting to take down the engine check around once again to be sure that there is no connection left undone.**

33. Take down the engine.

> **CAUTION:**
> **Make sure to avoid the engine cooling fan from touching against the shroud panel in removing the engine.**

Throughout this MANUAL, the four cylinders of the engine are identifie.. y numbers; No. 1, No. 2, No. 3 and No. 4 as counted from front end.

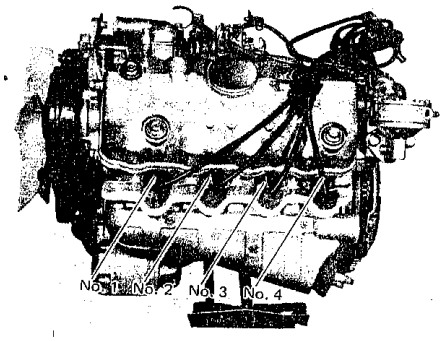


Fig. 3-3

3-4. Engine Disassembly

NOTES:

- Observe critically before starting to remove a component or part by loosening bolts, nuts and the like. What you may find before and during disassembly is valuable information necessary for successful reassembly.
- Be careful in handling aluminum-alloy parts. They are softer than steel or cast-iron parts and their finished surfaces more easily take scratch marks.
- Have trays and pans ready for setting aside the disassembled parts in an orderly manner. place the parts in the trays and pans in such a way that they can be readily identified. Put match marks or tags on them, as necessary, so that they will go back to where they came from.

Carry out engine disassembly in the following sequence:

Loosen drain plug and drain out engine oil.

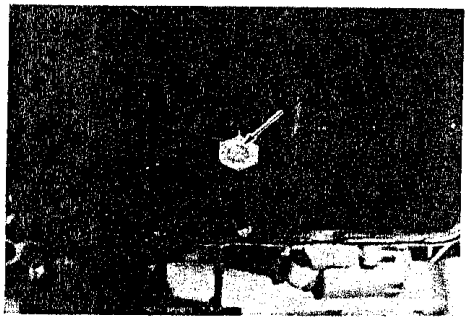


Fig. 3-4

Remove clutch cover.

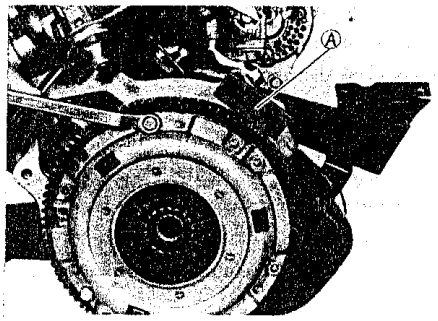


Fig. 3-5 Ⓐ Flywheel stopper

Remove distributor assembly.

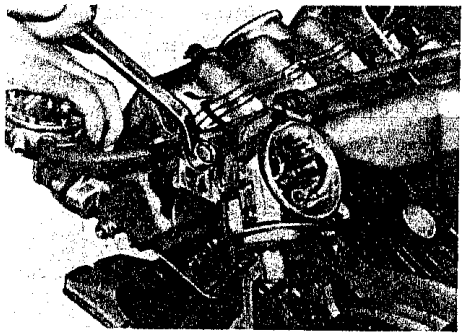


Fig. 3-6

Remove fuel pump.

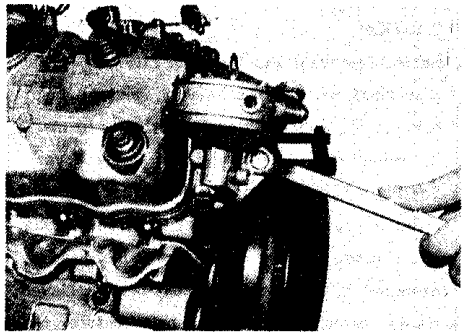


Fig. 3-7

Take down distributor case.

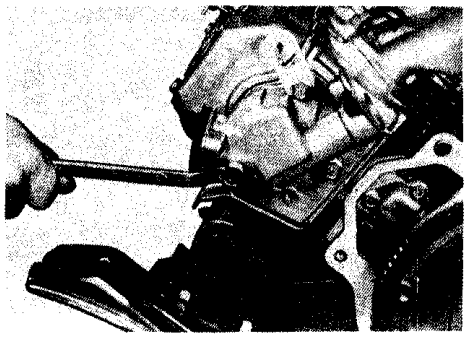


Fig. 3-8

Remove cooling fan.

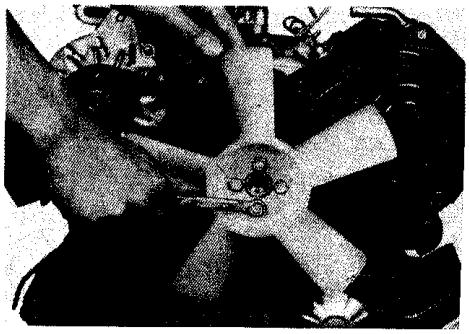


Fig. 3-9

Take down alternator.

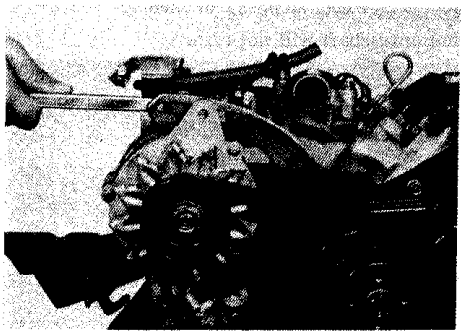


Fig. 3-10

Remove alternator mounting stay.

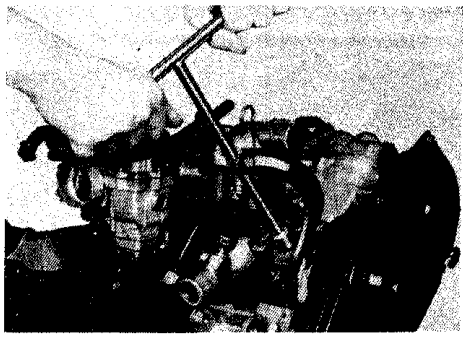


Fig. 3-11

Remove thermostat cap.

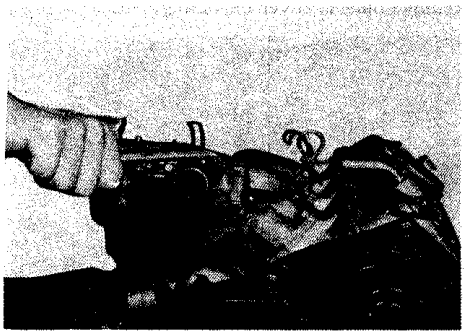


Fig. 3-12

Remove crank pulley similarly, with special tool Ⓐ (flywheel stopper) hitched to flywheel so that crankshaft will not turn.

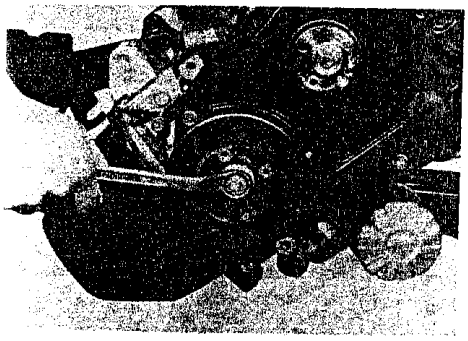


Fig. 3-13

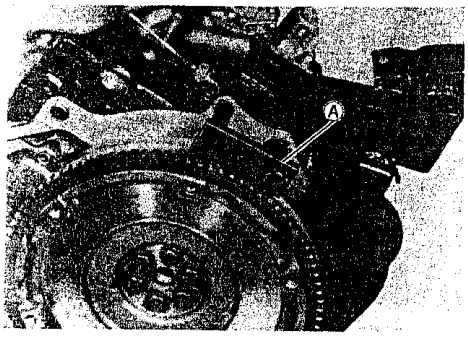


Fig. 3-14

Remove outside cover on timing belt.

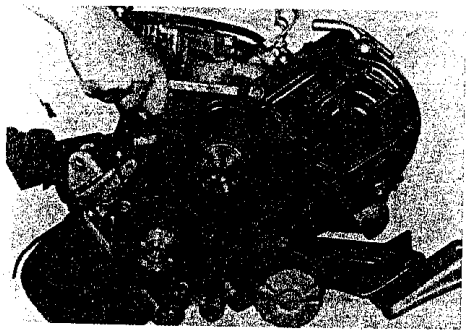


Fig. 3-15

Remove timing belt tensioner.

CAUTION:

Before removing the tensioner, turn over the crankshaft to bring its keyway ① to a point between 80°and 100° on the left side of mark ② provided on the timing belt inside cover. See Fig. 3-16. This positioning is necessary in order to prevent the piston crown from coming into contact with the valve. The valve could be damaged if this contact should occur. Never rotate camshaft or crankshaft before the cylinder head or rocker arms are removed.

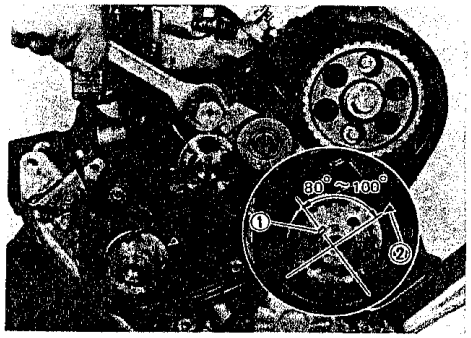


Fig. 3-16

Remove timing belt.

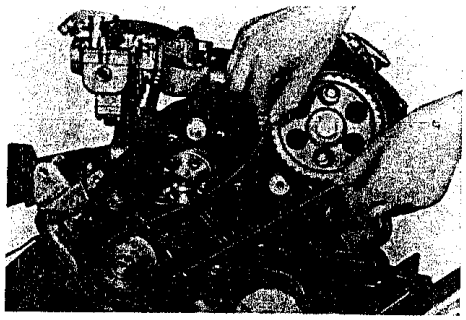


Fig. 3-17

Remove the camshaft timing belt pulley, with special tool (camshaft lock holder) attached, as shown, to lock the camshaft.

CAUTION:
Do not rotate camshaft when removing the pulley.

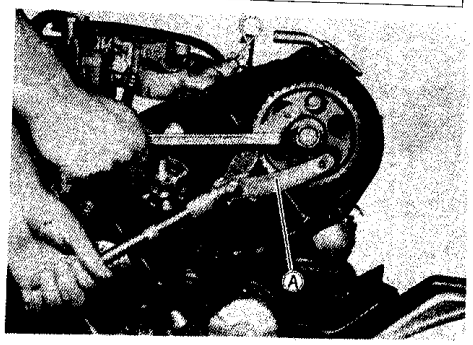


Fig. 3-18

Similarly remove the crankshaft timing belt pulley.

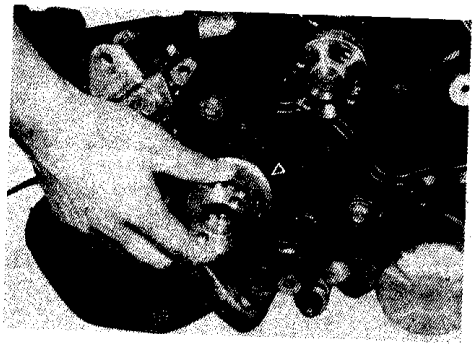


Fig. 3-19

After removing the pulley key, take out timing belt guide.

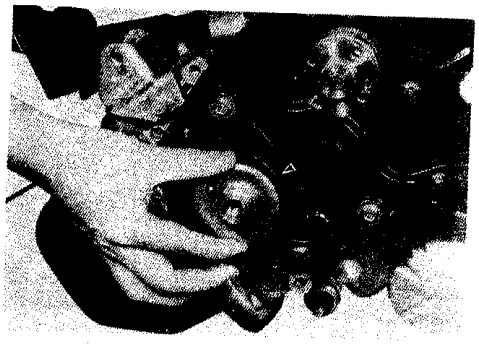


Fig. 3-20

Take down timing belt inside cover.

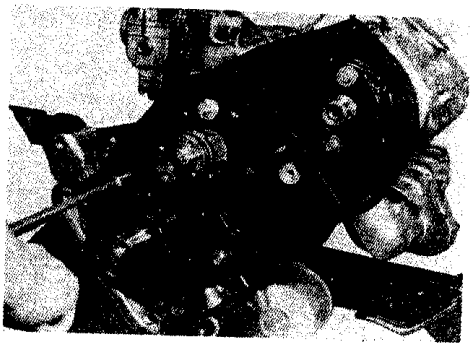


Fig. 3-21

Remove cylinder head front side case.

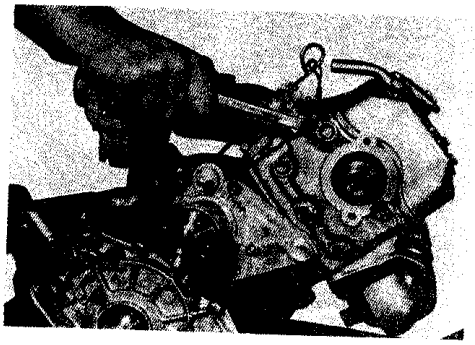


Fig. 3-22

Remove water pump case.

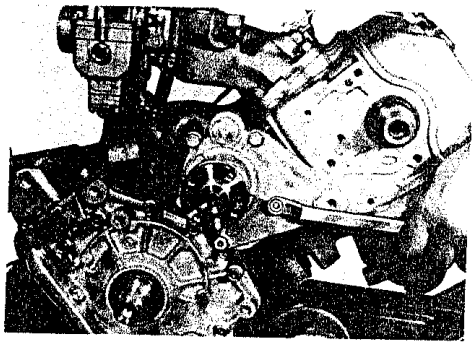


Fig. 3-23

Remove exhaust manifold cover.

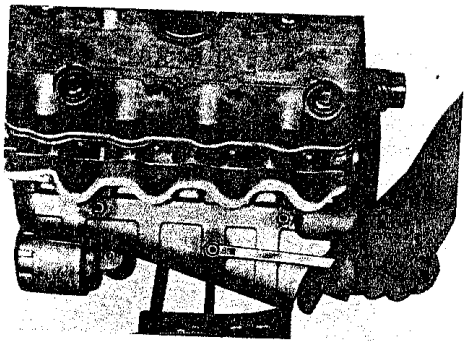


Fig. 3-24

Take off exhaust manifold and its gasket.

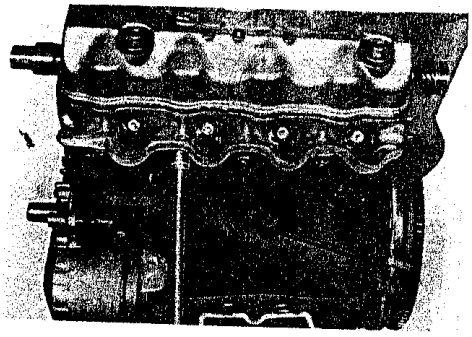


Fig. 3-25

Using special tool (oil filter wrench Ⓐ), to remove oil filter.

NOTE:

Be careful not to spill the oil when removing the filter.

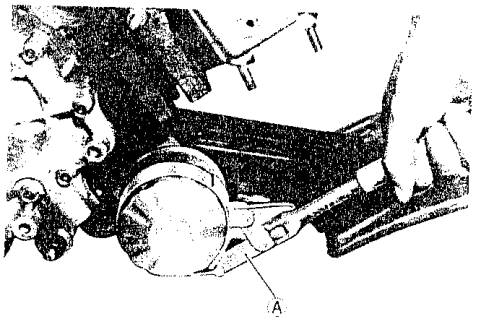


Fig. 3-26

Draw bypass hose off inlet manifold.

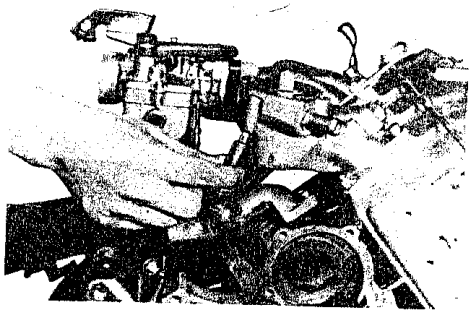


Fig. 3-27

Take down inlet manifold.

Fig. 3-28

Remove water inlet pipe.

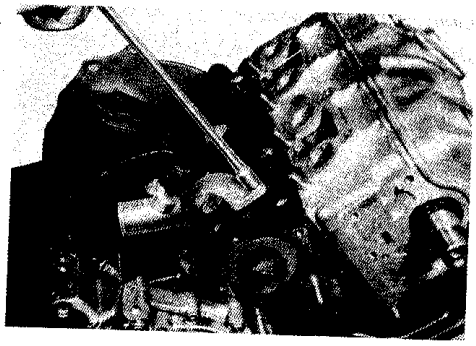


Fig. 3-29

Take off cylinder head cover.

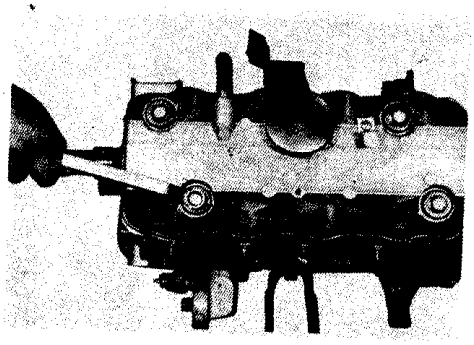


Fig. 3-30

Loosen the *8* valve adjusting screws fully. Leave the screws in place.

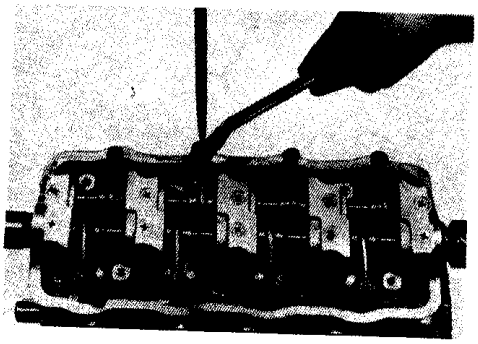


Fig. 3-31

Loosen rocker arm shaft securing screws : there are *10* screws.

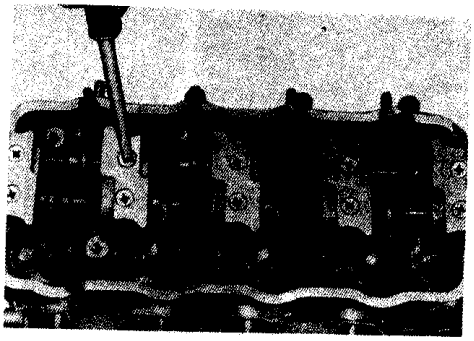


Fig. 3-32

While drawing out rocker arm shaft, separate valve rocker arms and rocker arm springs.

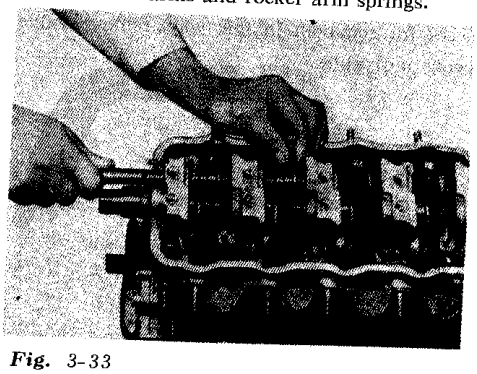


Fig. 3-33

Remove camshaft thrust plate, and draw camshaft out toward front end.

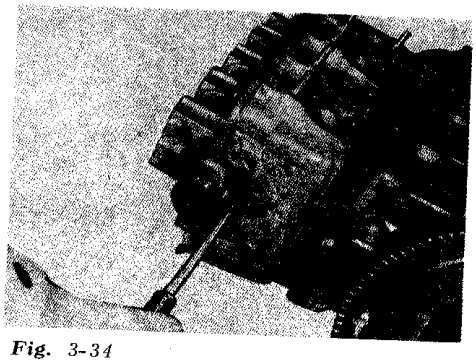


Fig. 3-34

Remove cylinder head.

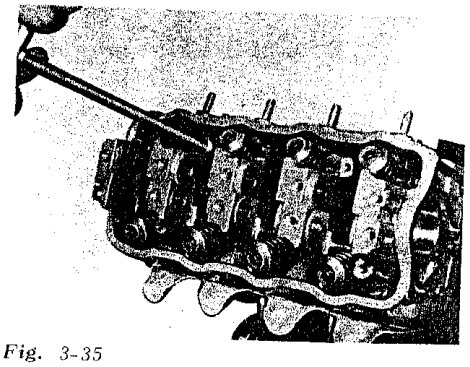


Fig. 3-35

Use valve lifter Ⓐ (*09916-14510*) to compress the valve spring in order to free valve cotter pieces for removal. In this way, remove valve spring and valves.

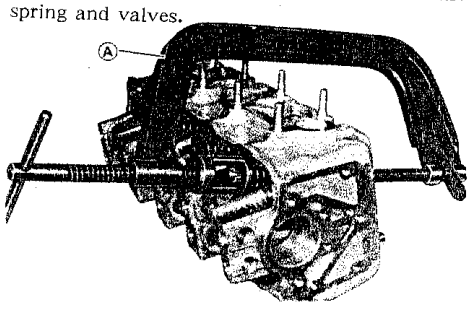


Fig. 3-36

Remove flywheel, using special tool Ⓐ (*09916-97910*) as shown.

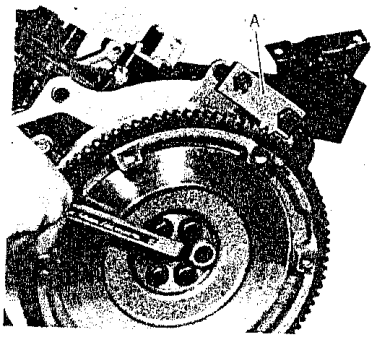


Fig. 3-37

Remove alternator bracket.

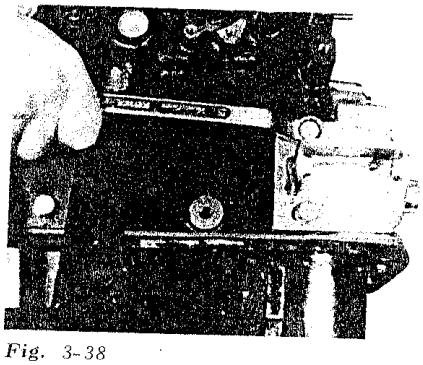


Fig. 3-38

Remove engine mounting bracket from cylinder block. (R, L)

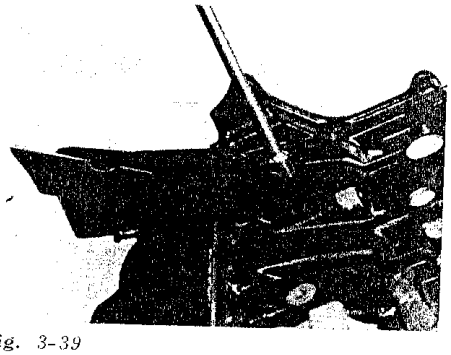


Fig. 3-39

Take down oil pan.

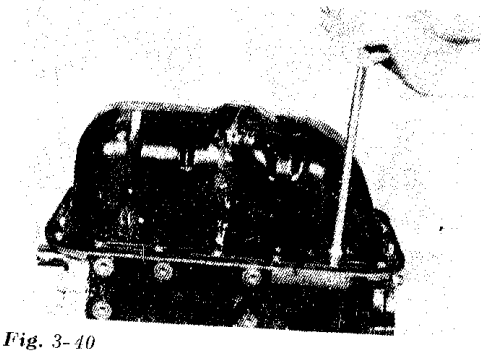


Fig. 3-40

Remove oil pump strainer.

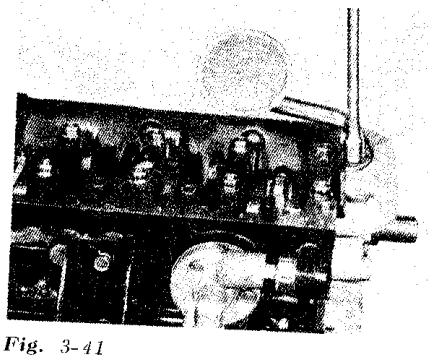


Fig. 3-41

As the first step of crankshaft removal, remove the connecting rod caps for No. 2 and No. 3 cylinders, and take out pistons, each complete with its connecting rod, from cylinder head side.

CAUTIONS:

- **Before pulling the piston out. scribe the cylinder number on its crown.**
- **Never drive on the big end in an attempt to force the piston out. If driving is necessary to ease the big end off crankpin, run stud bolts into the big end and drive on the bolts with a mallet handle.**
- **Be sure to identify each bearing cap for its connecting rod by using the cylinder number. Set the cap and rod aside in combination.**

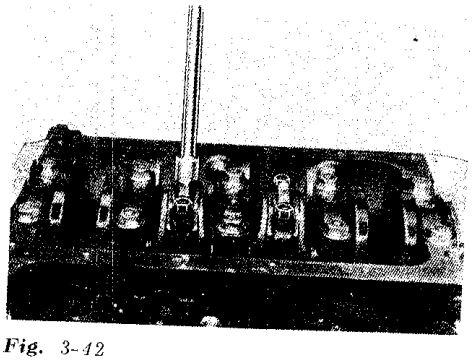


Fig. 3-42

Remove the connecting rod caps for No. 1 and No. 4 cylinders and, as mentioned above, take out the pistons and connecting rods.

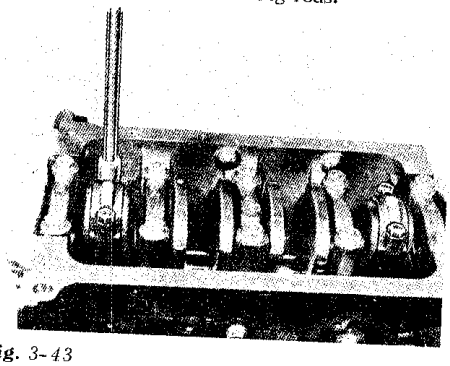


Fig. 3-43

Remove crankshaft rear oil seal assy.

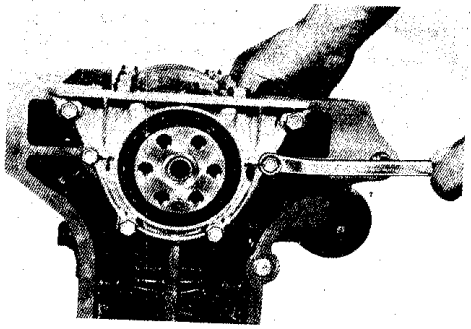


Fig 3-44

Remove crankshaft bearing caps, and take out crankshaft.

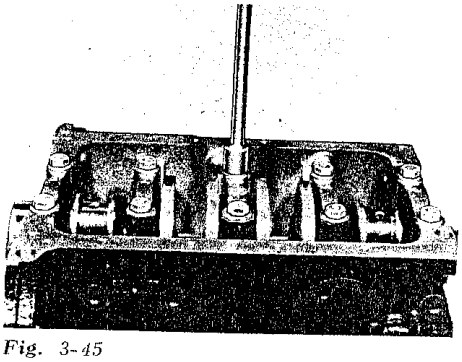


Fig. 3-45

From each piston, ease out piston pin circlips, as shown.

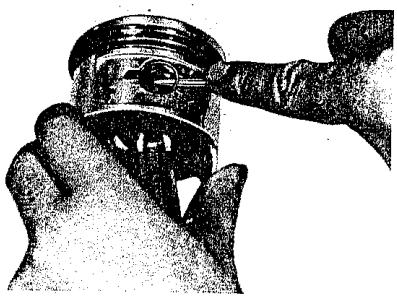


Fig. 3-46

Force piston pin out.

CAUTIONS:

- Before removing the pin, scribe the cylinder number on the connecting rod.
- Set the piston, piston pin and connecting rod, together with cap, in the tray or pan as a combination.

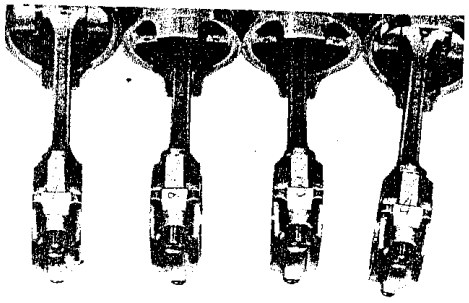


Fig. 3-47

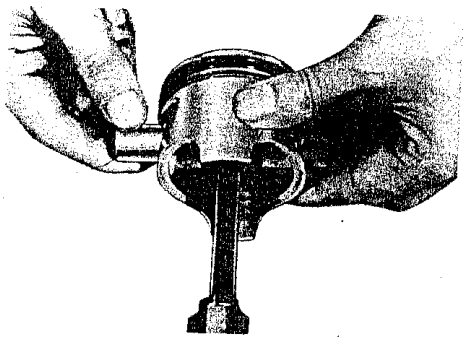


Fig. 3-48

3-5. Engine Maintenance Service

NOTES:

- During and immediately after disassembly, inspect the cylinder block and head for evidence of water leakage or damage and, after washing them clean, inspect more closely.
- Wash all disassembled parts clean, removing grease, slime, carbon and scales, before inspecting them to determine whether repair is necessary or not.
  Be sure to de-scale the water jackets.
- Use compressed air to clear internal oil holes and passages.
- Do not disturb the set combinations of valves, bearings and bearing caps, etc. Have the sets segregated and identified.

Cylinder head

●De-carbon the cylinder head:

Deposits of carbon will be found on its combustion chamber surfaces and exhaust ports. Remember, overheating tendency and loss of output are often due to excessive carbon accumulation. De-carbon the valves, too.

NOTE:
Do not use any sharp-edged tool to scrape off the carbon. Be careful not to scuff or nick the metal surfaces when de-carboning.

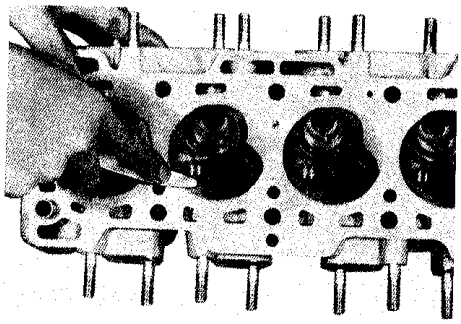


Fig. 3-49

●Flatness of gasketed surface:

Using a straightedge and thickness gauge, check the flatness at a total of *6* locations. If the limit, stated below, is exceeded, correct the gasketed surface with a surface plate and sandpaper of about *# 400*: place the sandpaper on and over the surface plate and rub the gasketed surface against the sandpaper to grind off high spots. Should this fail to reduce the thickness gauge readings to within the limit, replace the cylinder head.

Leakage of combustion gases from this gasketed joint is often due to a warped gasketed surface; such leakage results in reduced power output and hence a higer cost of fuel per kilometer.

Limit on flatness	under 0. 05mm (0. 002in.)

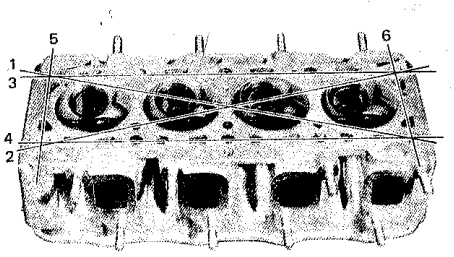


Fig. 3-50

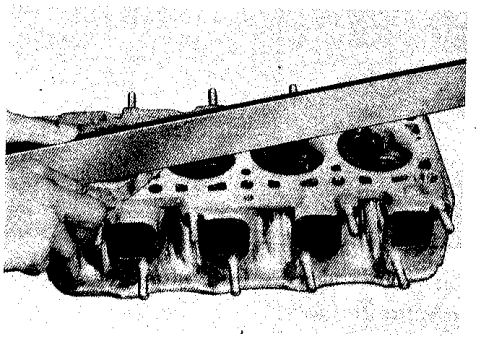


Fig. 3-51

●Flatness of manifold seating faces:

Check the seating faces of cylinder head for manifolds, using a straightedge and thickness gauge, in order to determine whether these faces should be corrected or the cylinder head replaced.

Limit on flatness	under 0. 10mm (0. 004in.)

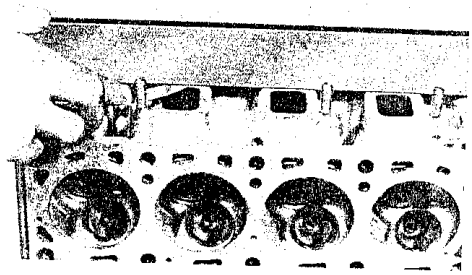


Fig. 3-52 Checking exhaust manifold seating face for flatness

Item		Standard	Limit
Rocker arm I. D.		14. 985-15. 005mm (0. 590-0. 591in.)	-
Rocker-arm shaft dia.		14. 965-14. 980mm (0. 589-0. 590in.)	-
Arm-to-shaft clearance	Inlet	0. 005-0. 040mm (0. 0002-0. 0016in.)	0. 07mm (0. 0027in.)
	Exhaust	0. 005-0. 040mm (0. 0002-0. 0016in.)	0. 07mm (0. 0027in.)

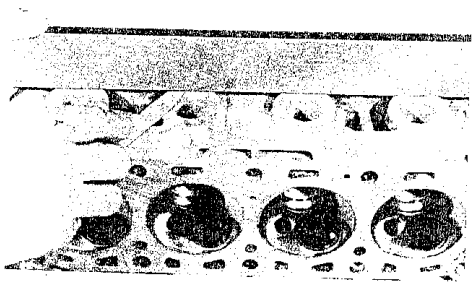


Fig. 5-53 Checking inlet manifold seating face for flatness

(The checking method of the flatness of exhaust manifold seating faces is the same above.)

Rocker-arm shaft and rocker arms

●Wear:

Check these parts for wear and, as necessary, replace them. The extent of wear is determined on the basis of two readings, one on rocker arm I. D. and the other on shaft diameter.

NOTE:
Use a micrometer on rocker-arm shaft and a caliper on rocker arm. The difference between the two readings is the arm-to-shaft clearance on which a limit is specified. If the limit is exceeded, replace shaft or arm, or both.

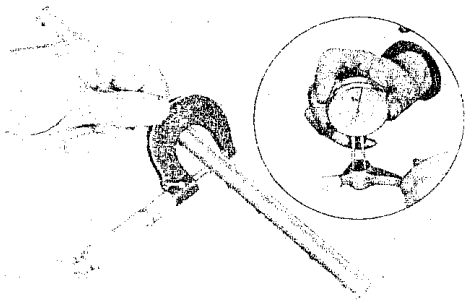


Fig. 3-54

●Rocker-arm shaft deflection:

Using "V" blocks and a dial gauge as shown in Fig. 3-55 , check the shaft for straightness in terms of deflection. If the limit is exceeded, correct it by cold-working with a wooden mallet or replace it.

Deflection limit	under 0. 06mm (0. 0023in.)

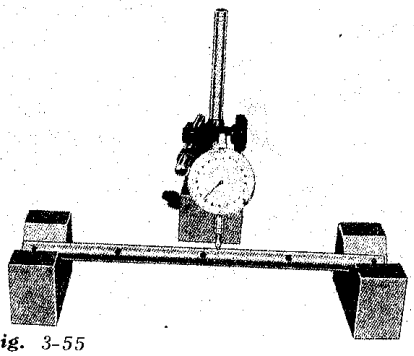


Fig. 3-55

● If the tip ① of adjusting screw ② is badly worn, replace the screw. The arm must be replaced if its cam-riding face ③ is badly worn.

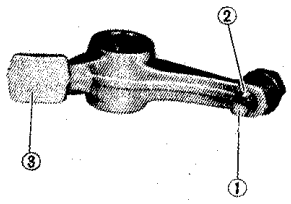


Fig. 3-56

● Visually examine each rocker-arm spring for evidence of breakage or weakening. Be sure to replace springs found in bad condition.

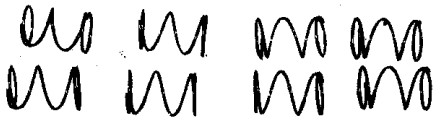


Fig. 3-57

Valve guides

● Using a micrometer and caliper, take diameter readings on valve stems and guides to determine the stem clearance in the guide. Be sure to take a reading at three places along the length of each stem and guide, as shown in Fig. 3-58.

Item		Standard	Limit
Valve stem diameter	Inlet	6.965-6.980mm (0.2742-0.2748in.)	-
	Exhaust	6.955-6.970mm (0.2738-0.2744in.)	-
Valve guide I.D.	Inlet	7.000-7.015mm (0.2755-0.2761in.)	-
	Exhaust	7.000-7.015mm (0.2755-0.2761in.)	-
Stem-to-guide clearance	Inlet	0.020-0.050mm (0.0008-0.0019in.)	0.07mm (0.0027in)
	Exhaust	0.030-0.060mm (0.0012-0.0023in.)	0.09mm (0.0035in.)

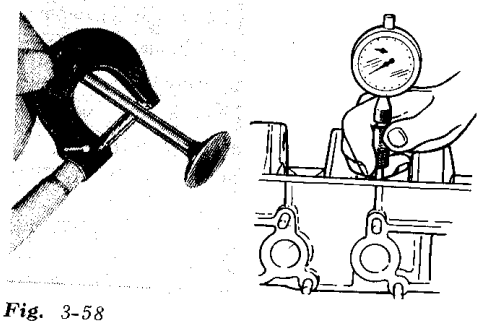


Fig. 3-58

If the caliper like the one shown in Fig. 3-58 is not available, check the end deflection of the valve stem in place with a dial gauge rigged as shown in Fig. 3-59. Move the stem end in the directions ④ ⑤ and determine whether replacement is necessary or not, by referring to these limiting values:

Valve stem end deflection	Inlet	0. 12mm (0. 0047in.)
	Exhaust	0. 16mm (0. 0063in.)

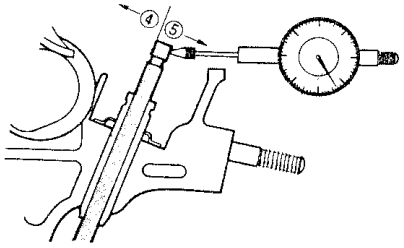


Fig. 3-59

●Valve guide replacement:

Valve guides are shrink-fitted. The method of removal and installation is as follows:

1) Using the guide remover (valve guide remover)drive the valve guide out to remove it from the top side of cylinderhead. After driving the guide out, ream the guide hole with a 12 mm (0. 472 in.)reamer (Special tool -valve guide reamer) to remove burrs, making sure that the hole diameter after reaming comes within this range:

Valve guide hole diameter	Inlet	12. 030-12. 048mm (0. 4736-0. 4743in.)
	Exhaust	

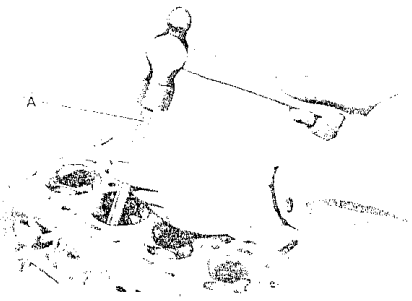


Fig. 3-60

2) Heat the cylinder head uniformly to anywhere between 80℃ and 100℃ (176°F-212°F) so that the head will not distort, and drive the oversize guide into the hole with the valve guide installer set Ⓑ . See Fig. 3-61. Be sure to carry out this step speedily so that all guides will go into the cylinder head in steady temperature state.

Valve guide oversize	0. 03mm(0. 0012in.)
Valve guide prorrusion l	16. 5mm(0. 619in.)

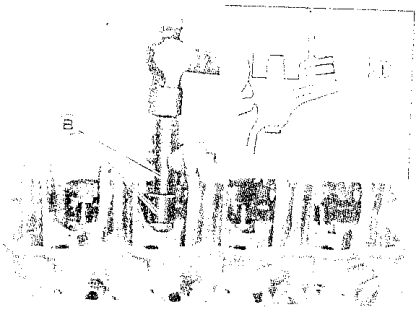


Fig. 3-61

NOTE:
Valve guide length both for INLET and EXHAUST is the same. It is 48 mm.

3)Check all valve guides and, stems in place for I. D. and, if the clearance reading indicates too small, ream the guide I. D. with the reamer Ⓒ as shown in Fig. 3-62.

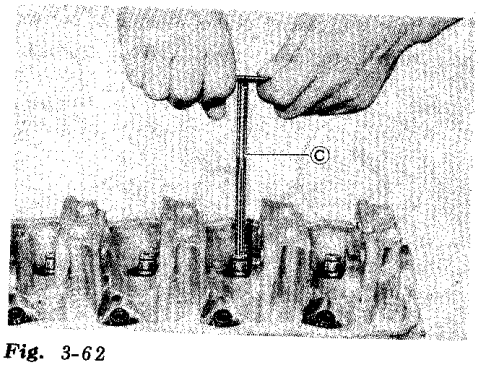


Fig. 3-62

Valves

- Inspect each valve for wear, burn or distortion at its face and stem and, as necessary, replace it.
- Measure the thickness ② of valve head. If the limit given to this thickness is exceeded, the valve must be replaced.

Valve head thickness ②

Standard	Limit	
0. 8-1. 2mm (0. 031-0. 047in.)	Inlet	0. 6mm(0. 0236in.)
	Exhaust	0. 7mm(0. 0275in.)

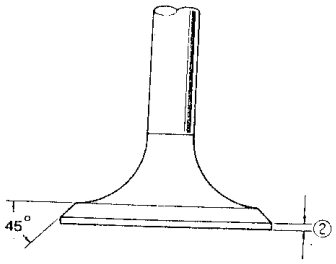


Fig. 3-63

● Check the end face of each valve stem for wear. This face meets the rocker arm intermittently in operation, and might become concaved or otherwise irregular. As necessary, smoothen the end face with an oil stone and, if this grinding removes the end stock by as much as 0. 5 mm (0. 0196 in.) (as measured from the original face), replace the valve.

Replacement valves have their stems machined to the follwowing diameter ranges.

Standard valve stem diameter	Inlet	6. 965-6. 980 mm (0. 2742-0. 2748in.)
	Exhaust	6. 955-6. 970mm (0. 2738-0. 2744in.)

●Check each valve for radial runout with a dial gauge and "V" block, as shown in Fig. 3-64. The object of this check is to determine whether the valve stem is concentric relative to the head.

Limit on valve head radial runout	0. 03mm(0. 0012in.)

If the limit is exceeded, do not attempt to correct the stem; replace the valve, instead.

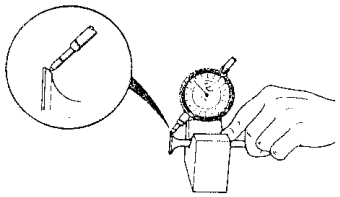


Fig. 3-64

Valve seats

CAUTION:
The valves to be checked and serviced for seating width and contact pattern must be those found satisfactory in regard to stem clearance in the guide and also the requirements stated in the preceding part titled VALVES.

●Seating contact width:

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

The pattern produced on the seating face of the valve must be a continuous ring without any break, and the width Ⓦ of the pattern must be within the stated range.

Standard seating width revealed by contact pattern on valve face: Ⓦ	Intake	1. 3-1. 5mm (0. 0512-0. 0590in.)
	Exhaust	

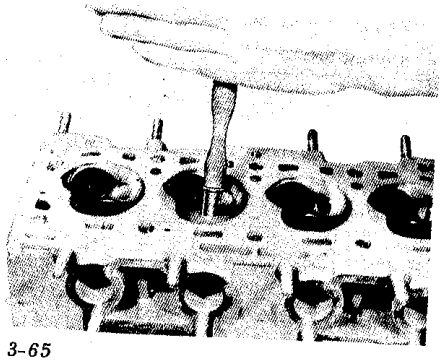


Fig. 3-65

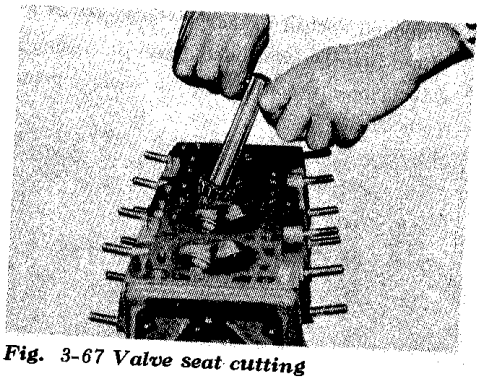


Fig. 3-67 Valve seat cutting

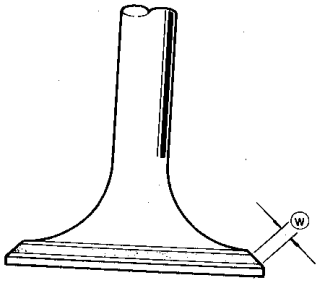


Fig. 3-66

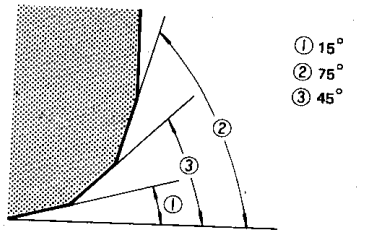


Fig. 3-68 Valve seat angles for exhaust valve seat

●Valve seat repair:

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

1) EXHAUST VALVE SEAT: Use a special valve seat cutter to make three cuts in the order illustrated in Fig. 3-68. Three cutters must be used: the first for making the 15° angle, the second for making the 75° angle and the last for making the 45° seat angle. The third cut ③ must be made to produce the desired seat width Ⓦ.

Seat width Ⓦ for exhaust valve seat	1. 3-1. 5mm (0. 0512-0. 0590in.)

2)INLET VALVE SEAT:

The cutting sequence is the same as for exhaust valve seats but the second angle differs, as will be noted in Fig. 3-69.

Seat width Ⓦ for inlet valve seat	1. 3-1. 5mm (0. 0512-0. 0590in.)

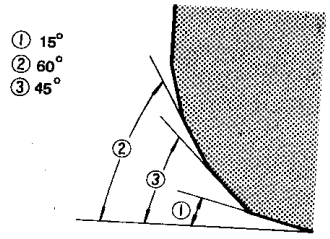


Fig. 3-69 Valve seat angles for inlet valve seat

3)VALVE LAPPING: Lap the valve on the seat in two steps, first with a coarsesize lapping

compound applied to the face and the second with a fine-size compound, each time using a valve lapper according to the usual lapping method.

Fig. 3-70 Applying lapping compound to valve face

NOTES:

- After lapping, wipe the compound off the valve face and seat, and produce a contact pattern with a red-lead paste. Check to be sure contact width and specified pattern area must be reached.

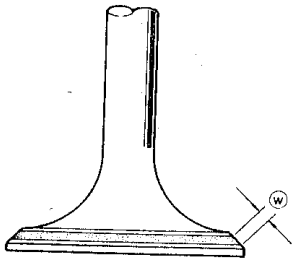


Fig 3-71 Contact pattern Ⓦ uniform in width

Valve springs

- Referring to the criteriondata given below, check to be sure that each spring is in sound condition, free of any evidence of breakage or weakening. Remember, weakened valve springs can be the cause of chatter, not to mention the possibility of reducing the power output due to gas leakage caused by decreased seating pressure.

Item	Standard	Limit
Valve spring free length	47.7mm (1.8779in.)	46.5mm (1.8307in.)
Valve spring preload	26-30kg for 40mm (57.3-66.1lb/1.57in.)	24kg for 40mm (52.9lb/1.57in.)

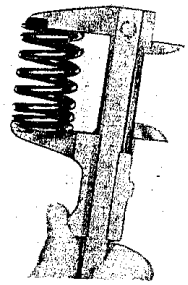


Fig. 3-72 Measuring free length of spring

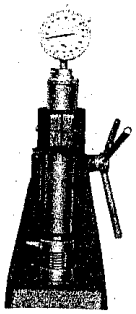


Fig. 3-73 Checking the spring for preload

- Spring squareness:

Use a square and surface plate to check each spring for squareness in terms of the clearance ①, Fig. 3-74, between the end of valve spring and the square. Valve springs found to exhibit a larger clearance than the limit must be replaced.

Valve spring squareness ① limit	2. 0mm (0. 079in.)

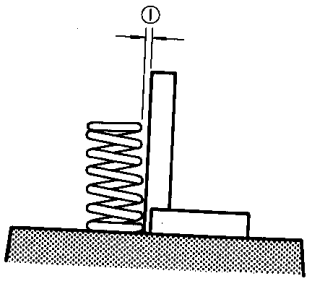


Fig. 3-74

Camshaft

A noisy engine or an engine producing not enough power is frequently due to its camshaft excessively worn or bent or bowed. The wear could occur on its cams and journals.

●Camshaft deflection:

Hold the camshaft between two center points, as shown in Fig. 3-75, with a dial gauge rigged up to measure its deflection. Replace the camshaft if the amount of deflection so measured exceeds the limit.

Camshaft deflection limit	0. 10mm (0. 0039in.)

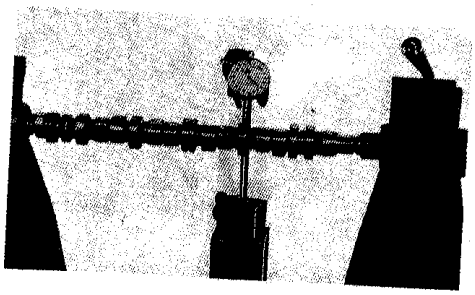


Fig. 3-75

●Cam wear:

Measure the height Ⓗ of each cam. If any of the micrometer readings taken is down to or less than the limit, replace the camshaft.

Cam height Ⓗ	Standard	Limit
Inlet cam	36. 152mm (1. 4233in.)	36. 100mm (1. 4212in.)
Exhaust cam	36. 152mm (1. 4233in.)	36. 100mm (1. 4212in.)
Pump drive cam	33. 300mm (1. 3110in.)	33. 000mm (1. 2992in.)

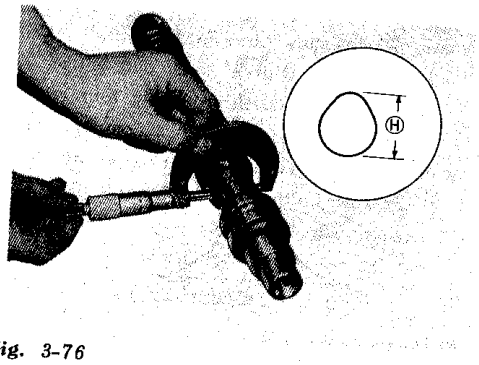


Fig. 3-76

● Thrust clearance:

Using a thickness gauge, measure this clearance as shown in Fig. 3-77, at the thrust plate. If the limit is exceeded, replace thrust plate of camshaft.

Item	Standard	Limit
Thrust clearance	0. 050-0. 150mm (0. 0019-0. 0059in.)	0. 300mm (0. 0118in.)

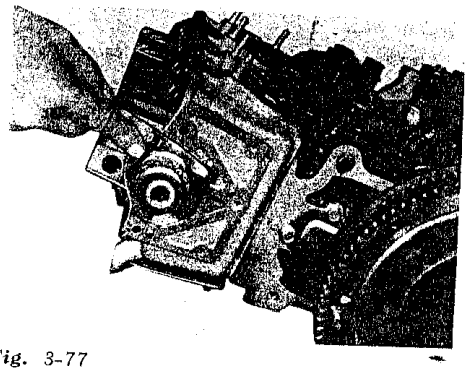


Fig. 3-77

●Journal wear:

Measure the journal diameter in two directions at two places to obtain four readings on each journal (as shown in Fig. 80); and check the journal bores with a I. D. dial gauge , as shown in Fig. 3-79, producing four readings on each. From these readings, compute the radial clearance (camshaft journal clearance). If the service limit is exceeded by any of the computed radial clearances, replace the camshaft and, as necessary, cylinder head, too.

Item	Standard	Limit
Journal clearance	0. 050-0. 091mm (0. 0020-0. 0036in.)	0. 15mm (0. 0059in.)

Camshaft journal dia.	Journal bore dia.
ⓐ 44. 225 ~ 44. 250mm (1. 7411~1. 7421 in)	44. 300~44. 316 mm (1. 7441~1. 7447 in)
ⓑ 44. 225 ~ 44. 250mm (1. 7411~1. 7421 in)	44. 300~44. 316mm (1. 7441~1. 7447in)
ⓒ 44. 025 ~ 44. 050mm (1. 7332~1. 7342in)	44. 100~44. 116mm (1. 7362~1. 7368 in)
ⓓ 43. 825 ~ 43. 850mm (1. 7254~1. 7264 in)	43. 900~43. 916mm (1. 7283~1. 7289in)
ⓔ 43. 625 ~ 43. 650mm (1. 7175~1. 7185in)	43. 700~43. 716mm (1. 7205~1. 7210in)
ⓕ 43. 425~43. 450mm (1. 7096~1. 7106in)	43. 500~43. 516mm (1. 7126~1. 7132in)

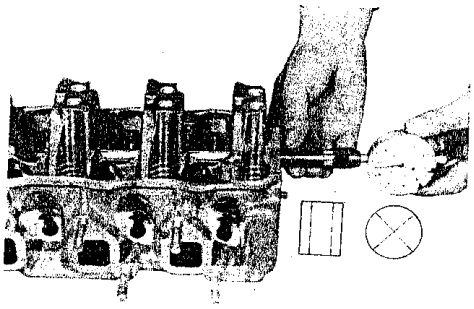


Fig. 3-79

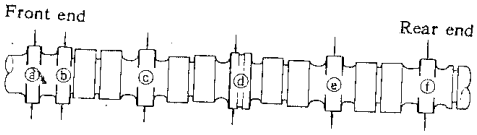


Fig. 3-78

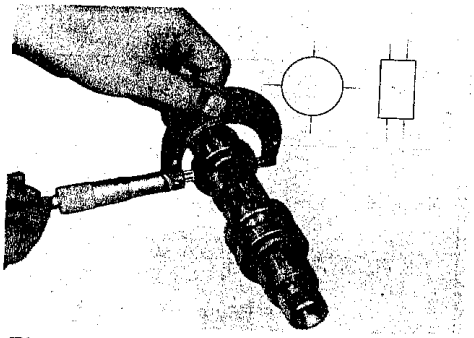


Fig. 3-80

Cylinder block

●Flatness of gasketed surface:

By the same method that is prescribed for checking the flatness of the gasketed surface of the cylinder head, check the top face of the cylinder block for flatness and, if the flatness is found to exceed the limit, machine the face with a surface grinder.

Limit on flatness	0. 05mm (0. 0020in.)

Fig. 3-81

●Cylinder bore:

Using a dial measure the diameter of each bore in two directions, longitudinal and transverse, at three places, top, middle and bottom, as indicated in Fig. 3-82, to obtain a total of 6 readings. On the basis of these readings taken on each bore, determine whether the maximum difference in diameter between any two bores exceeds the limit. If the limit, stated below, is exceeded or if the bore wall is badly scored or burned, re-bore all cylinders to the next oversize and use oversize pistons in engine reassembly.

Piston oversize	0. 25mm(0. 0098in.)
	0. 50mm(0. 0196in.)

CAUTION:

If any one of the four cylinders has to be re-bored, re-bore the four to the same next oversize. This is necessary for the sake of uniformity.

When replacing the pistons or installing oversize pistons, be sure that the piston-to-cylinder clearance comes within the stated range:

Limit on difference in diameter between any two cylinders	0. 05mm (0. 0020in.)
Piston-to-cylinder clearance	0. 040-0. 050mm (0. 0016-0. 0020 in.)

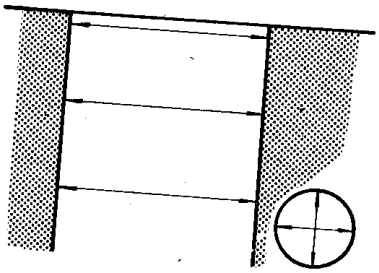


Fig. 3-82

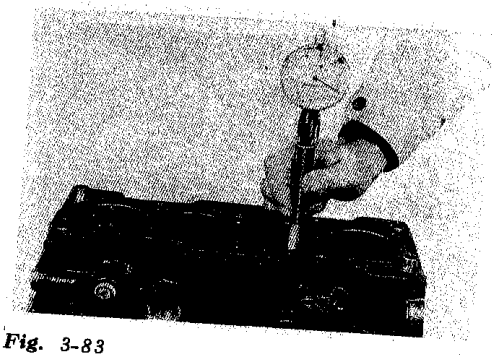


Fig. 3-83

Piston and piston rings

●Piston diameter:

Piston-to-cylinder clearance, mentioned above, is equal to the bore diameter minus the piston diameter, which is to be measured by

measuring at the level of the piston in the direction transverse to piston pin axis, as shown in Fig. 3-84. This Level Ⓗ from the skirt end is 30 mm (1. 18in.) high.

Piston diameter	Standard	61. 960-61. 975mm (2. 4393-2. 4399in.)
	Oversize	62. 460-62. 475mm (2. 4590-2. 4596in.)

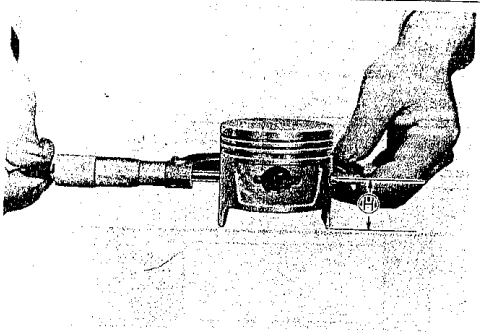


Fig. 3-84

- Inspect the outer surface of each cylinder for evidence of burn and for scratch or groove marks. Minor flaws can be removed by grinding with fine-grain sandpaper.
- De-carbon the piston crown and ring grooves, using a soft-metal scraping tool.

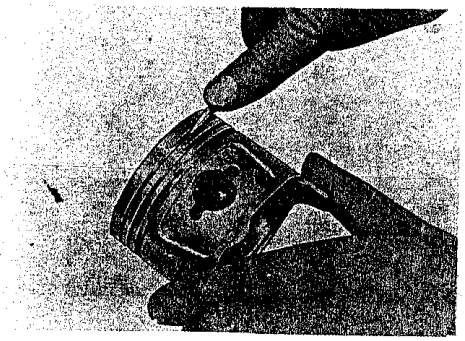


Fig. 3-85

- Ring clearance in the groove:

Using a thickness gauge, check each piston ring in its groove for side clearance and , if the limit stated below is exceeded, measure the groove width and ring width to determine whether the piston or the ring or both have to be replaced.

Item		standard	Limit
Ring clearance in the groove	Top ring	0. 03-0. 07mm (0. 0012-0. 0027in.)	0. 12mm (0. 0047in.)
	2nd ring	0. 02-0. 06mm (0. 0008-0. 0023in.)	0. 10mm (0. 0039in.)

Piston ring thickness	Top ring	1. 47-1. 49mm (0. 0578-0. 0586in.)
	2nd ring	1. 47-1. 49mm (0. 0578-0. 0586in.)
	Oil ring	0. 45mm (0. 0177in.)
Ring groove width	Top ring	1. 52-1. 54mm (0. 0598-0. 0606in.)
	2nd ring	1. 51-1. 53mm (0. 0594-0. 0602in.)
	Oil ring	2. 81-2. 83mm (0. 1106-o. 1114in.)

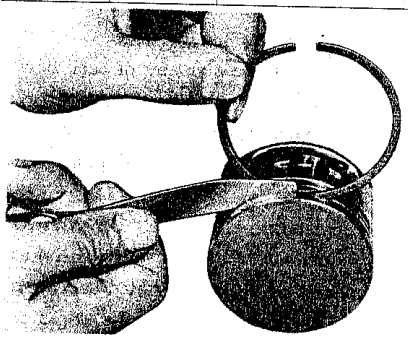


Fig. 3-86

- Piston ring end gap:

To measure the end gap, insert the piston ring into the cylinder bore, locating it at the lowest part of the bore and holding it true and square; then use a thickness gauge to measure the gap. If the gap measured exceeds the limit, replace the ring.

Item		Standard	Limit
Piston ring end gap	Top & 2nd rings	0. 15-0. 35mm (0. 059-0. 0137in.)	0. 7mm (0. 0275in.)
	Oil ring	0. 30-0. 90mm (0. 0118-0. 0354in.)	1. 8mm (0. 0708in.)

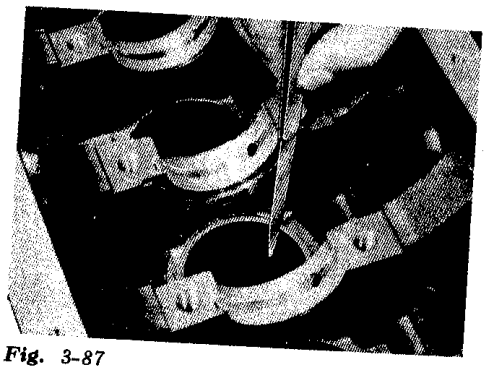


Fig. 3-87

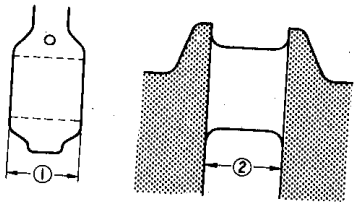
Connecting rods

●Big-end thrust clearance:

Check the big end of each connecting rod for thrust clearance, with the rod fitted and connected to its crank pin in the normal manner. If the clearance measured is found to exceed the limit, the connecting rod of the crankshaft, whichever is responsible for the excessive clearance, must be replaced.

Item	Standard	Limit
Big-end thrust clearance	0. 10-0. 20mm (0. 0039-0. 0078in.)	0. 30mm (0. 0118in.)

① Width of big end	21. 95-22. 00mm (0. 864-0. 866in.)
② Width of crank pin	22. 10-22. 15mm (0. 870-0. 872in.)



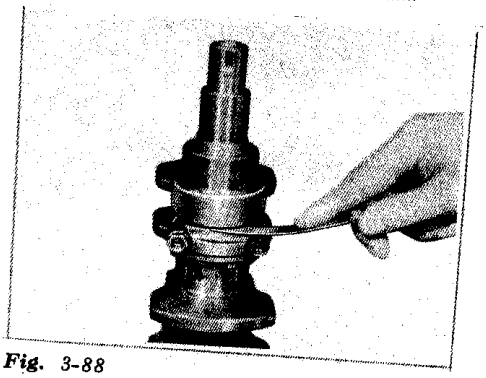


Fig. 3-88

●Connecting rod alignment:

Mount the connecting rod on the aligner to check it for bow and twist and, if the limit is exceeded, replace it.

Limit on bow	0. 05mm(0. 0020in.)
Limit on twist	0. 10mm (0. 0039in.)

●Inspect the small end of each connecting rod for wear and evidence of crack or any other damage, paying particular attention to the condition of its bush. Check the piston pin clearance in the small end. Replace the connecting rod if its small end is badly worn or damaged or if the clearance checked exceeds the limit.

Item	Standard	Limit
Pin clearance in small end	0. 003-0. 016mm (0. 0001-0. 0006in.)	0. 05mm (0. 0020in.)

Small-end I. D.	16. 003-16. 011mm (0. 6300-0. 6303in.)

Piston Pin dia.	15. 995-16. 000mm (0. 6297-0. 6299in.)

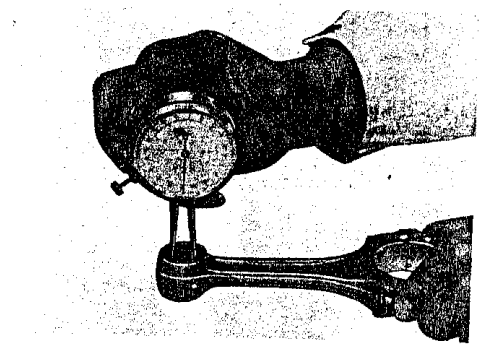


Fig. 3-89

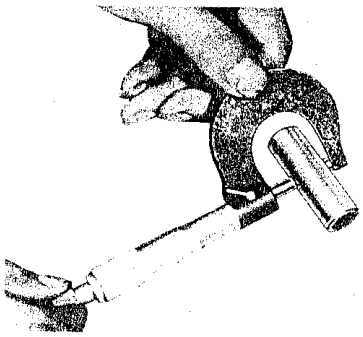


Fig. 3-90

Connecting-rod big end bearings

●Inspect the bearing shells for signs of fusion, pitting, burn or flaking and observe the contact pattern. Bearings found in defective codition through this inspection must be replaced.

CAUTION:
Bearing shells are not meant to be repaired by scraping or grinding with sandpaper or by any machining. The remedy is to replace them.

●Crankpin-to-bearing clearance:

Check this clearance by using fuse stock or, preferably, PLASTIGAGE. Here' s how to use PLASTIGAGE:

1) Prepare, by cutting, a length of PLASTIGAGE roughly equal to bearing width and place it axially on crankpin, avoiding the oil hole.

2) Make up the big end in the normal manner, with bearing shells in place and by tightening the cap to the specification.

NOTE:
Never rotate crankshaft or turn connecting rod when a piece of PLASTIGAGE is in the radial clearance.

Bearing cap tightening torque	27. 4-31. 4N • M

NOTE:
When fitting bearing cap to crankpin, be sure to discriminate between its two ends, front and rear.

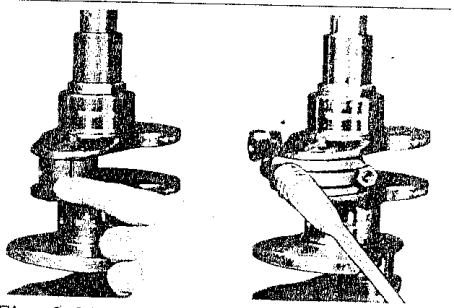


Fig. 3-91

3) Remove the cap, and measure the width of flattened PLASTIGAGE piece with the PLASTLGAGE envelope scale. This measurement must be taken at the widest part.

Item	Standard	Limit
Crankpin-to-bearing clearance	0. 020-0. 040mm (0. 0008-0. 0016in)	0. 080mm (0. 0031in.)

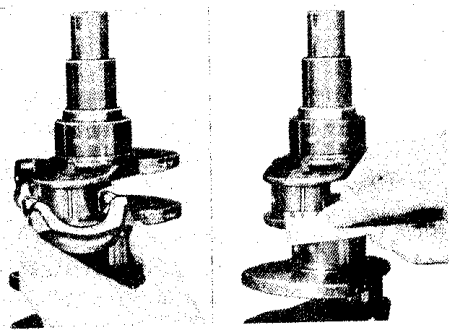


Fig. 3-92

4) If the limit, indicated above is exceeded. replace the bearing. Re-grind the crankpin if still exceeded.

Bearing size	Crankpin diameter
Standard	37.985-38.000mm (1.4954-1.4960in.)
0.25-mm undersize	37.735-37.750mm (1.4856-1.4862in.)
0.50-mm undersize	37.485-37.500mm (1.4760-1.4763in.)

Where undersize bearings are used, the clearance specification is slightly lenient:

Radial clearance for undersize bearing	0.020-0.070mm (0.0008-0.0027in.)

Crankshaft

●Deflection:

Check the crankshaft for deflection, as shown in Fig. 3-93, and if the dial gauge reading exceeds the limit, repair or replace the crankshaft.

Limit on crankshaft deflection	0.06mm (0.0023in.)

NOTE:
Measure the deflection at the center journal.
Rotate the crankshaft slowly.

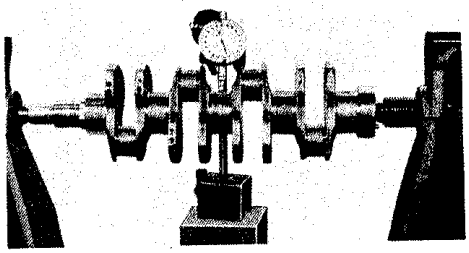


Fig. 3-93

●Crankshaft thrust play:

Measure this play with crankshaft set in the cylinder block in the normal manner, that is, with the thrust bearing fitted and the bearing caps installed. Use a dial gauge to read the displacement in axial (thrust) direction of the crankshaft. If the limit is exceeded, replace the existing thrust bearing by the oversize one.

Item	Standard	Limit
Crankshaft thrust play	0.13-0.28mm (0.0051-0.0110in.)	0.35mm 0.0138in.)
Thickness of crank-shaft thrust bearing	Standard	2.500mm (0.0984in.)
	Oversize 0.125mm (0.0049in.)	2.563mm (0.1009in.)
	Oversize 0.250mm (0.0098in.)	2.625mm (0.1033in.)

Tightening torque for cap bolts	42.1~47N • M

Tightening torque for the bolts securing the bearing caps is specified.

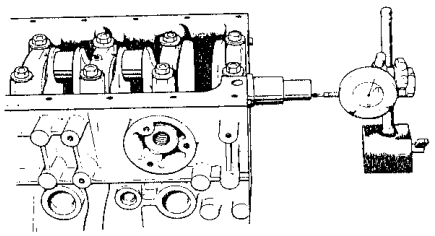


Fig. 3-94

●Out-of round and taper (uneven wear):

An unevenly worn crankshaft journal or crankpin shows up as a difference in diameter at a cross section or along its length (or both). This difference, if any, is to be determined from micrometer readings taken as shown in Fig. 3-95.

If any of the journals or crankpins is badly damaged or if the amount of uneven wear in the sense explained above exceeds the limit, repair (by re-grinding) or replace the crankshaft.

Limit on uneven wear	0.01mm (0.0004in.)

NOTE:
Where journal or crankpin re-grinding is necessary, finish the diameter to the size necessary for the undersize bearing.

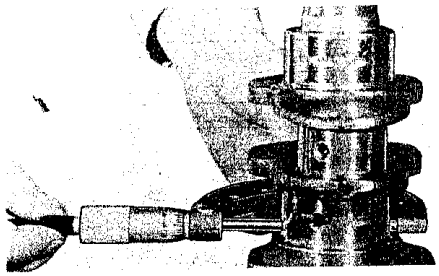


Fig. 3-95

Crankshaft journal bearings

●Inspect the bearing shells for signs of fusion, pitting, burn or flaking and observe the contact pattern. Defective shells must be replaced.

CAUTION:
As in the case of connecting-rod bearings, the journal bearing shells are not meant to be repaired by scraping or grinding with sandpaper or by any machining.

●Journal-to-bearing clearance:

Check this clearance by using fuse stock or, preferably, PLASTIGAGE. The following method is based on the use of PLASTIGAGE:

1) Cut the PLASTIGAGE stock to the required length (equal to the width of the bearing), and place it axially on the journal, avoiding the oil hole.

2) Mount the crankshaft in the usual manner, tightening the bearing caps to the specified torque value. (It is assumed that a PLASTIGAGE piece is pinched at each journal.) Do not rotate the crankshaft when PLASTIGAGE is in.

Tightening torque for cap bolts	42～47N・M

CAUTION:
Each of the five bearing caps has an arrow marked on it. Be sure to position each cap with its arrow pointing to front end and to match it to its journal. Remember, the four cylinders are numbered, 1, 2, 3, and 4, as counted from front end. See Fig. 3-96.

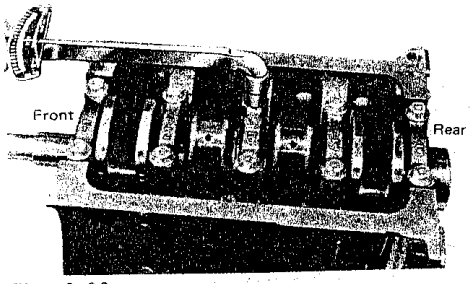


Fig. 3-96

3)Remove the caps and take out the PLASTIGAGE pieces, which are now flattened. By a dial, measure the width of the widest part of the piece, and determine whether the radial clearance checked (obtained from the PLASTIGAGE piece) is within the limit.

Item	Standard	limit
Journal-to-bearing clearance	0. 020-0. 040mm (0. 0008-0. 0016in.)	0. 08mm (0. 0032in.)

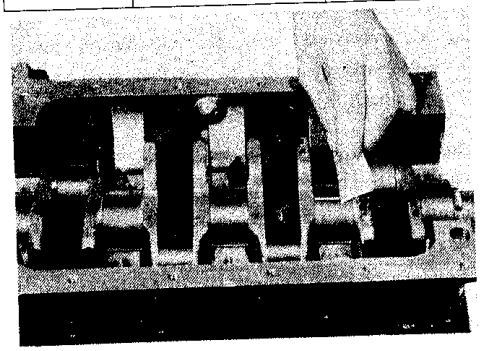


Fig. 3-97

4)If the limit is exceeded, re-grind the journals to the undersize and use the undersize bearing, or replace the bearing to contract the play.

Bearing size	Journal diameter
Standard	49. 985-50. 000mm (1. 9679-1. 9685in.)
0. 25mm undersize	49. 735-49. 750mm (1. 9580-1. 9586in.)
0. 50mm underaize	49. 485-49. 500mm (1. 9482-1. 9488in.)
Radial clearance for undersize bearing	0. 020-0. 070mm (0. 0008-0. 0027in.)

Flywheel

● Inspect the friction surface — the surface in contact with clutch disc — for wear and damage. Most of surface flaws, if any, can be removed by simple machining. A badly damaged flywheel must be replaced.

●Face runout:

Check the flywheel for face runout with a dial gauge, as shown in Fig. 3-98. Be sure that the runout is within the limit.

Limit on runout	0. 2mm (0. 0078in.)

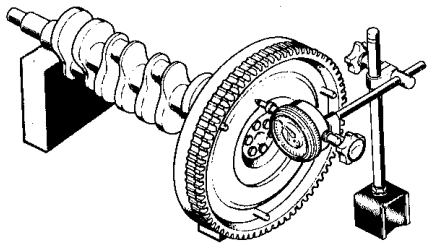


Fig. 3-98

●Ring gear tooth wear:

Inspect the teeth for wear and for evidence of crack, chipping or any other damage. Replace the ring gear if its teeth are found in bad condition.

Oil seals

Carefully inspect the oil seals removed in disassembly, examining the lip portion ① of each oil seal for wear and damage. Use of new oil seals in reassembly is recommended.

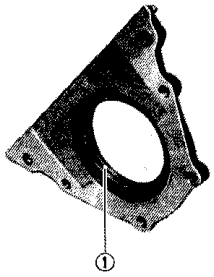


Fig. 3-99

Timing belt and timing pulleys

Inspect the belt and pulleys for wear, cracks and signs of failure. Replace them as necessary.

CAUTION:

- Do not bend the belt. Keep away oil and water from the belt. The belt must be kept clean.
- The pulleys and belt tensioner, too, must be kept clean and free of oil and water.

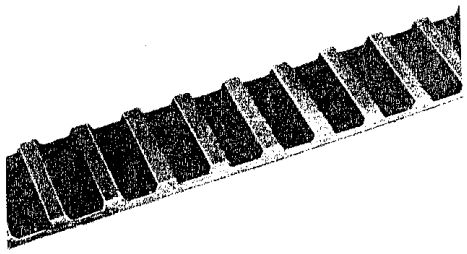


Fig. 3-100

3-6. Engine Reassembly

NOTE:

- All parts to be used in reassembly must be perfectly clean.
- Oil the sliding and rubbing surfaces of engine parts just before using them in reassembly. For the oil, use SAE 20W/40 grade, engine oil.
- Have the liquid packing ready for use, Anaerobic bond QY168/GY230 specified for the liquid. Use it wherever its use is specified in order to ensure leak-free (oil and water) workmanship of reassembly.
- There are many running clearances. During the course of engine reassembly, be sure to check these clearances, one after another, as they form.
- Gaskets, "O" rings and similar sealing members must be in perfect condition. For these members, use replacement parts in stock.

- Tightening torque is specified for important fasteners — bolts and nuts in the main — of the engine and other components. Use torque wrenches and constantly refer to the specified values.
- Do not disregard the match marks provided on parts. Some of them are those given at the time of disassembly.
- There are many sets of parts. Crankshaft bearings, connecting rods, pistons, etc, are in combination sets. Do not disturb the combinations and try to see that each part goes back to where it came from.

Tightening torque data

This is a list-up of bolts and nuts tightening jobs identified by parts to be secured:

What to tighten	N • M
Crankshaft bearing cap bolt	42. 1-47
Connecting-rod bearing nut	27. 4-31. 4
Crankshaft pulley bolt	49-58. 8
Flywheel bolt	39. 2-44. 1
Cylinder head bolt	53. 9-58. 8
Spark plug	19. 6-29. 4
Camshaft pulley bolt	49-58. 8
Valve adjusting nut	14. 7-19. 6
Oil drain plug	19. 6-24. 5
Oil pan securing bolt	3. 92-4. 9
Oil fiter	9. 8-14. 7
Oil filter stand	19. 6-24. 5
Oil pressure unit	11. 76-14. 7
Timing belt cover bolt	2. 94-3. 92

Engine reassembly is the reverse of engine disassembly as far as sequence is concerned, but there are many reassembling steps that involve measures necessary for restoring the engine as close to the factory-assembled condition as possible. Only those steps will be dealt with.

Crankshaft

Be sure to oil crankshaft journal bearings as shown.

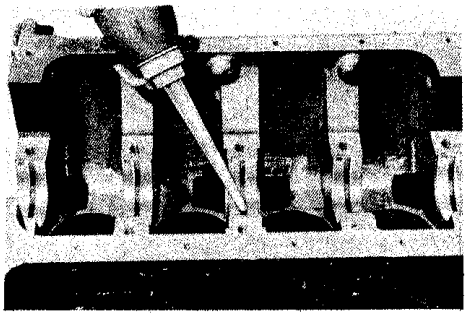


Fig. 3-101

Thrust bearings for the crankshaft are an item prone to escape the serviceman' s attention: be careful not to leave them out. These bearings go into place with their oil groove side facing the crank web.

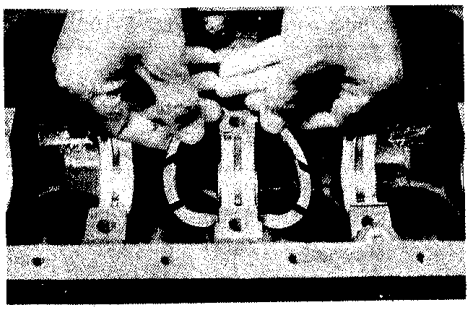


Fig. 3-102

Be sure to oil crankshaft journals as shown.

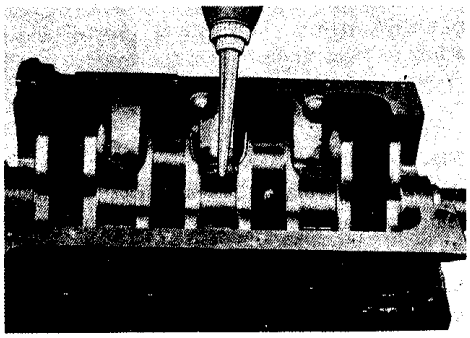


Fig. 3-103

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

Tightening torque for bearing cap blots	42. 1-47N•M; 4. 3-4. 8kg-m (31. 5-34. 5lb-ft)

Gradual and uniform tightening is important for bearing cap bolts. Make sure that the five caps become tight equally and uniformly progressively to the stated torque value.

NOTE:
After tightening cap bolts, check to be sure that crankshaft rotates smoothly when turned over by hand.

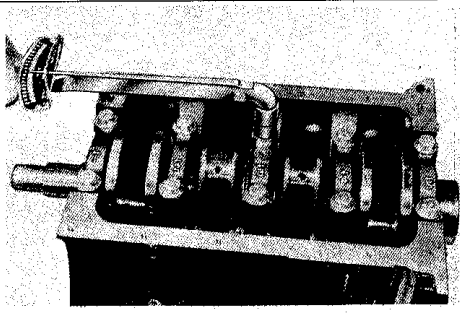


Fig 3-104

Oil seal housing

This housing demands new gasket; do not reuse the gasket removed in disassembly. After bolting the housing to the block, the gasket edges might bulge out; if so, cut off the edges to make the joint seam flat and smooth; use a sharp knife. After cutting, apply GY168 bond as shown.

NOTE:
Just before mounting the housing, oil the lip portion of the oil seal.

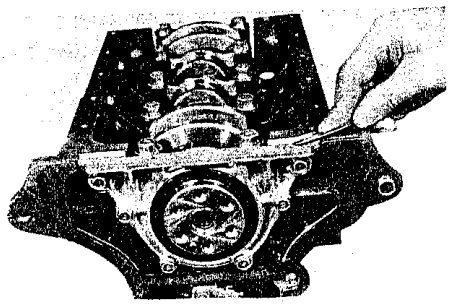


Fig. 3-105

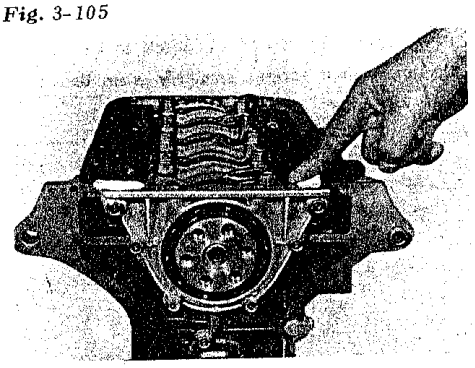


Fig. 3-106

Oil pump

The gasket for oil pump case must be new. As in the case of oil seal housing, cut off the gasket edges with a knife to smoothen the joint seam.

NOTE:
Before fitting the pump case, oil the oil seal lip.

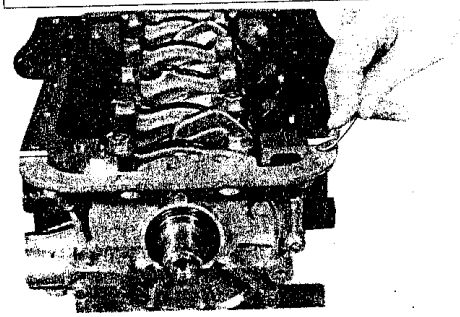


Fig. 3-107

After cutting the gasket edges, apply GY168 Anaerobic bond.

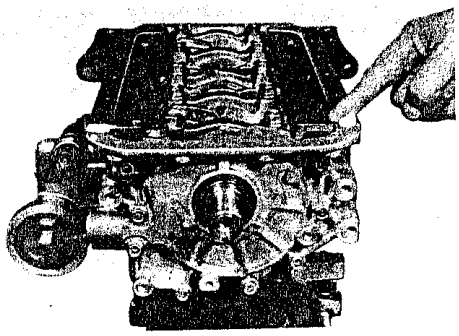


Fig. 3-108

POSITION OF PISTON RELATIVE TO CONNECTING ROD: The arrow ① on the crown points to front (pulley) side, and the oil hole ② comes on inlet port side. See Fig. 3-109.

NOTE:
Before pinning piston to connecting rod, oil the small end and pin holes.

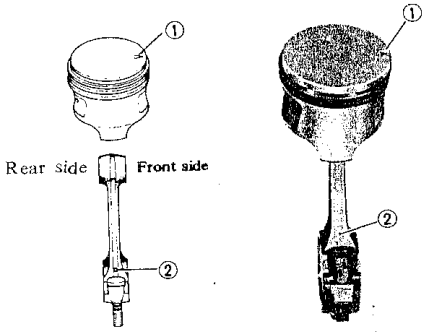


Fig. 3-109

Before fitting rings to piston, check to be sure that first ring has RN mark and second ring R mark. After mounting the three rings, distribute their end gaps as illustrated in Fig. 3-110. Remember, the marked side of each ring (1st and 2nd) comes on top side.

NOTE:
After fitting the rings, oil them in the grooves.

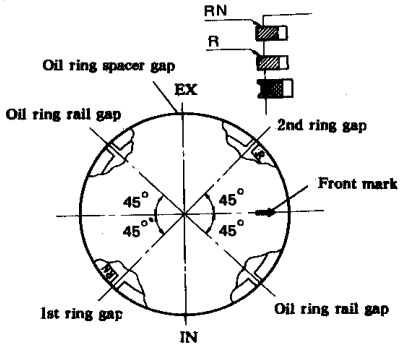


Fig. 3-110

Use of the piston ring compressor Ⓐ , Fig. 3-111, is mandatory in inserting pistons into cylinder block. Using this compressor Ⓐ , feed the piston and connecting rod combination into the bore from the upper side of cylinder block.

Pay attention to these reminders:

- Point the piston crown arrow to front side.
- Be sure that the number (marked on the crown at the tme of disassembly) tallies with the cylinder number.
- Liberally oil the big-end bearings before fitting them to crankpins.
- Oil the bore just before feeding in the piston.

CAUTION:
As the piston and connecting rod combination goes into the bore, the rod might hitch onto the cylinder wall or crank journal. In such a case, do not attempt to force piston in. If any hitch is felt, look into under crankshaft to clear the wall for the rod.

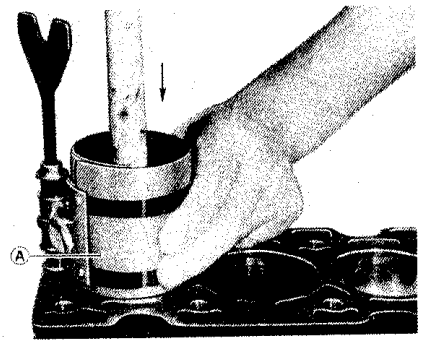


Fig. 3-111

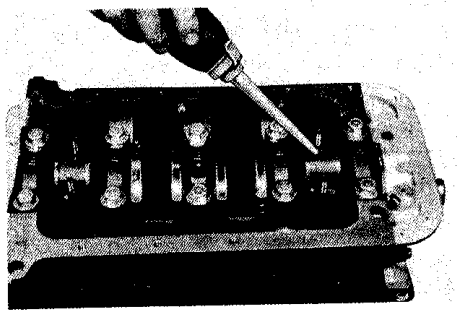


Fig. 3-112

Connecting rods

Two stoppers ① ② , Fig. 3-113 and 114, determine the position of bearing. At the time of installing these caps, be sure to locate stopper ① of cap in the direction of stopper ②.

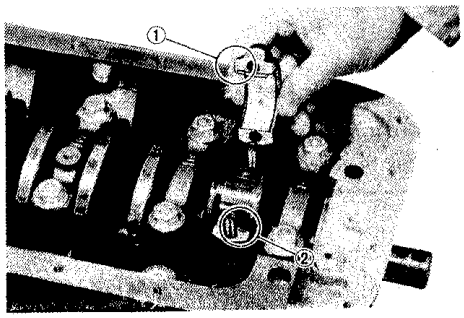


Fig. 3-113

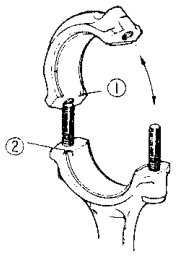


Fig. 3-114

After fitting all four big-end bearing caps, start tightening them uniformly, being sure to equalize tightness between right and left on each cap. The sequence here is similar to that for crankshaft bearing caps.

Tightening torque for big-end caps	27. 4-31. 3N • M

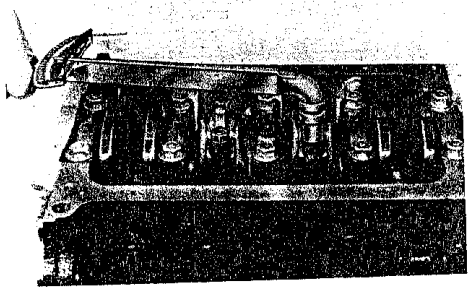


Fig. 3-115

NOTE:
After installing crankshaft and pistons, connecting rod assy as above, double-check to be sure that the arrows on piston crowns are all pointing to pulley (front) side.

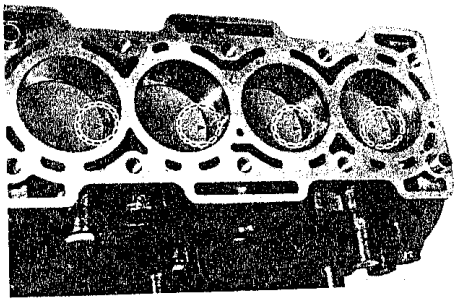


Fig. 3-116

Oil pump strainer

Bear in mind that "O" ring ① is often forgotten and left out in reassembly. Absence of this ring defeats the purpose served by the strainer.

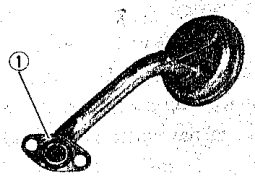


Fig. 3-117

Oil pan

After fitting the oil pan to the block, run in securing bolts and start tightening at the center: move wrench outward, tightening one bolt at a time.

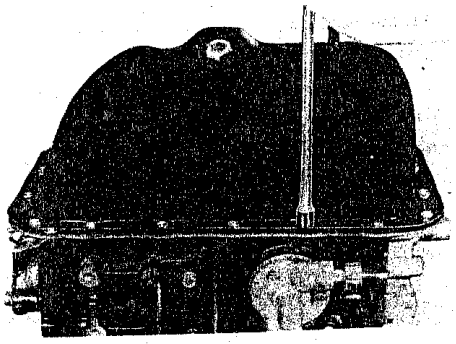


Fig. 3-118

Flywheel

The first step of flywheel installation is to check to be sure that locating pin ① is studded in the crankshaft. The next step is to fill up the pocket between input shaft bearing and oil seal ② with grease. Make this pocket 60% full.

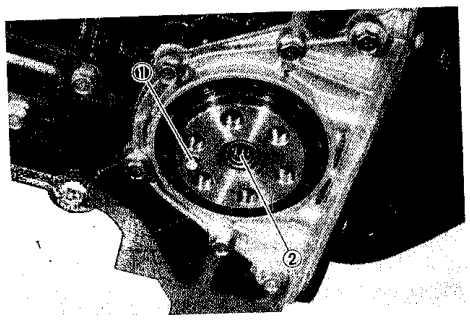


Fig. 3-119

Cylinder head

Oil valve stems before inserting them into guides.

CAUTION:
Be sure to distinguish between inlet valves and exhaust valves. The difference is in diameter and marking. Refer to the embossed marks, shown in Fig. 3-120.

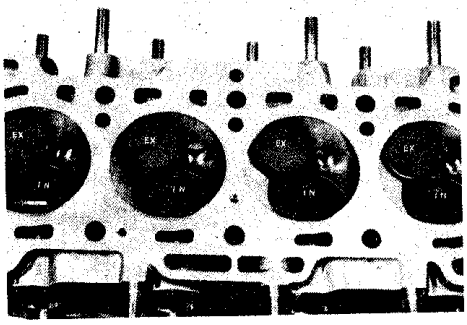


Fig. 3-120

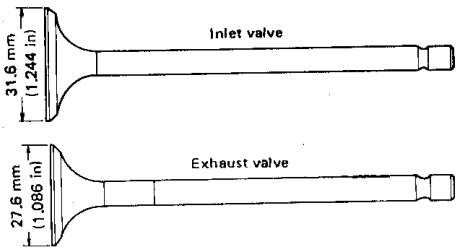


Fig. 3-121

Each valve spring has top end (large-pitch end) and bottom end (small-pitch end). Be sure to position the springs in place so that their bottom ends come on bottom side.

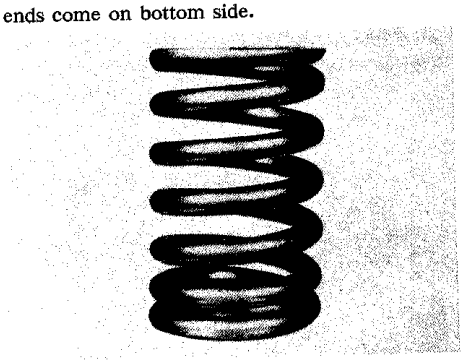


Fig. 3-122

To fit valve cotters to the groove provided on the end portion of each valve stem, be sure to use the valve lifter compress the valve spring with this lifter and mount the cotter pieces, as shown in Fig. 3-123.

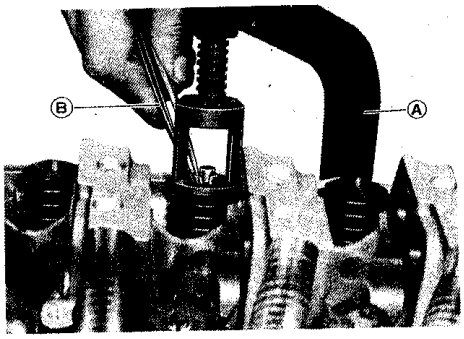


Fig. 3-123 Ⓑ Forceps

At the time of installing the cylinder head, be sure to position the head gasket correctly on the cylinder block. "TOP" mark ①, provided on the gasket, comes on top side; "IN" mark ② comes on inlet manifold side and "EX" mark ② comes on exhaust side.

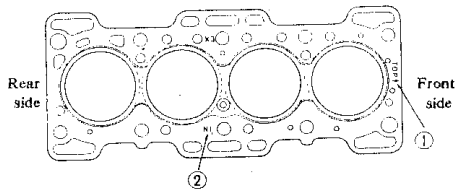


Fig. 3-124

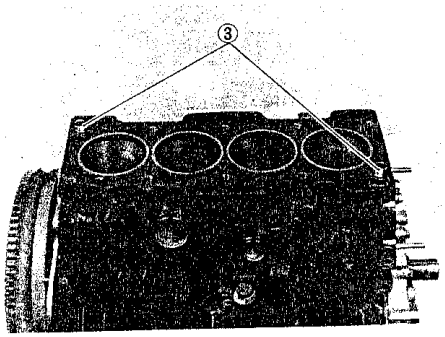


Fig. 3-125 ③ Locating pins

The position the cylinder head takes on the block is but one, which is shown in Fig. 3-126. When placing the head on the block, be sure that it is correctly oriented: It is the clue that the inlet ports ④ should be at the same side of the gasket marked "IN".

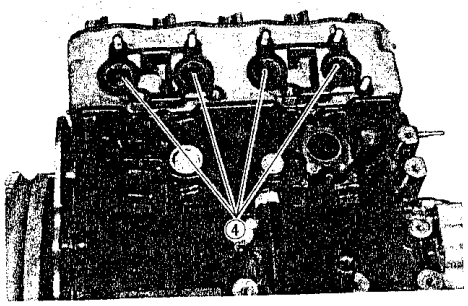


Fig. 3-126

The tightening sequence for cylinder head bolts is indicated in the photo. Tighten the bolts in that sequence to the specified torque value:

Tightening torque for cylinder head bolts	53.9-58.8N • M

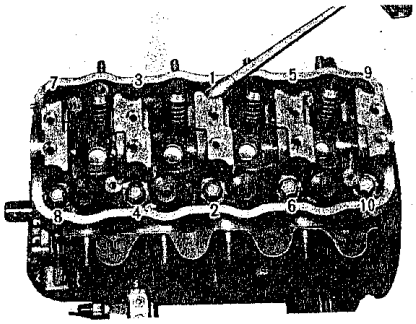


Fig. 3-127

Camshaft

The camshaft goes into cylinder head from front side. Before inserting it, be sure to oil its journals.

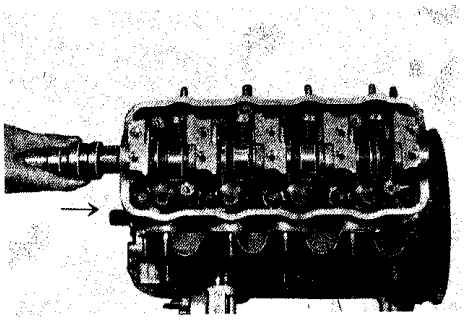


Fig. 3-128

Be careful not to leave out the thrust plate ① and turn the shaft by hand to be sure it rotates smoothly.

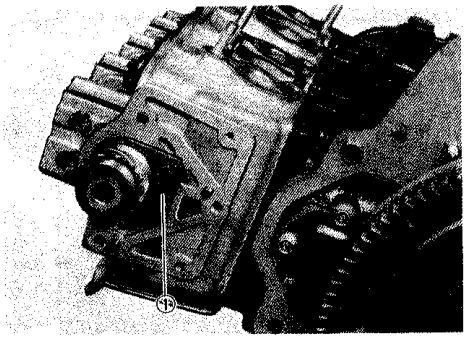


Fig. 3-129

Rocker-arm shafts

CAUTION:

Before installing the rocker-arm shaft on the head, be sure to locate the crankshaft keyway ② in the 80°-100° angular range, as shown in Fig. 3-130.

This crankshaft position is necessary because, if its keyway is in any other angular position, some valves will touch piston crowns, possibly resulting in damaged valves of piston crowns. Keep crankshaft in that angular position until the job of adjusting the timing belt tension is completed.

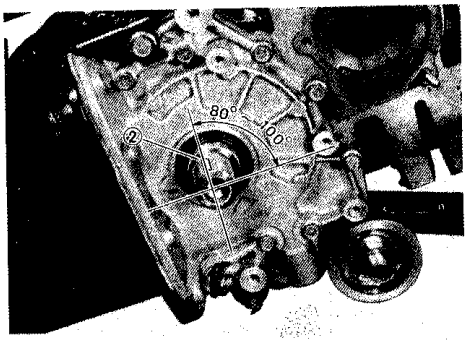


Fig. 3-130

The two rocker-arm shafts are identical, there being no need to distinguish between the two. However, each shaft takes but one position in place. See Fig. 3-131.

- On the inlet side, the stepped end ③ comes on front side.
- On the exhaust side, the stepped end ④ comes on rear side.

NOTE:

Oil rocker-arm shafts just before installing them.

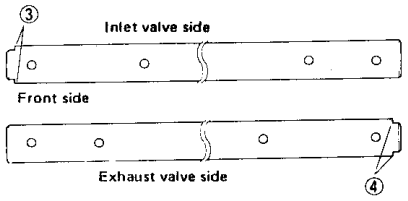


Fig. 3-131

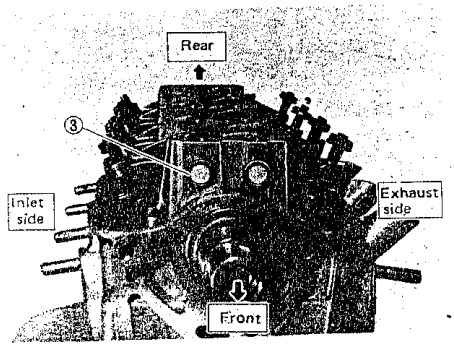


Fig. 3-132

As to the positions of rocker arms and springs on each rocker-arm shaft on INLET, rocker-arm spring is in front side, rocker-arm is in rear side on EXHAUST, it is in reverse, refer to Fig. 3-133. "Front side" is meant by "1"; "rear side" by "2".

NOTE:
When installing rocker-arm shafts, be sure to have valve adjusting screws loosened fully but do not remove them.

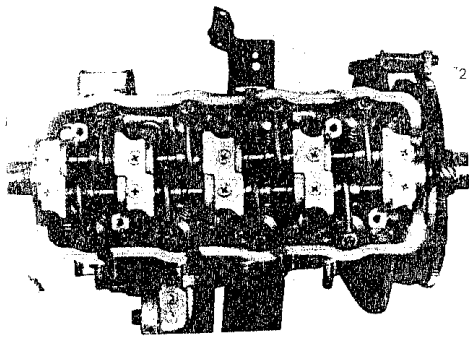


Fig. 3-133

Water inlet pipe

The angle that this pipe takes in place is important. When installing it, be sure to angle it as shown in Fig. 3-134.

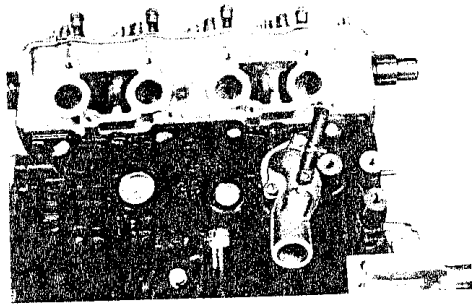


Fig. 3-134

Cylinder-head front side case

Two bolts ① for securing the front side case to cylinder head, Fig. 3-135, need to apply GY230, because the bolt holes for the two extend into the interior of cylinder head.

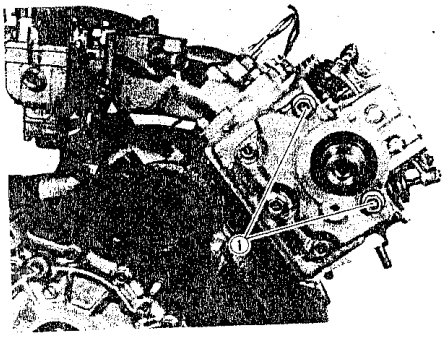


Fig. 3-135

Crankshaft timing belt guide

This guide takes its position on crankshaft as shown in Fig. 3-136. Remember, one side of this guide faces the cylinder block and the other side faces the timing belt pulley.

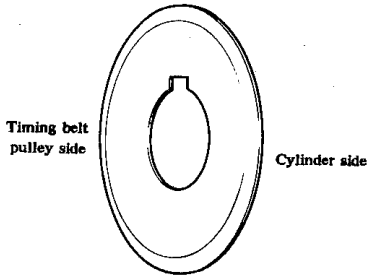


Fig. 3-136

Camshaft timing belt pulley

One side of this pulley has a punch mark ① as the reference for correctly positioning it on the camshaft. Fit the pulley to camshaft, bringing the punch-marked-side to fan side and locating the mark ① at the keyway ② provided in camshaft.

CAUTION:
Before installing the pulley as above, check to be sure that crankshaft keyway ③ is in the 80°—100° range, as shown in Fig. 3-137.

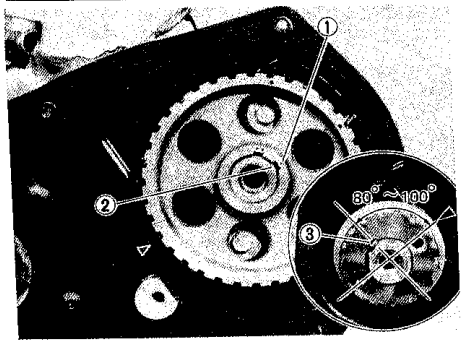


Fig. 3-137

Timing belt (valve timing adjustment)

A certain sequence must be followed installing the timing belt. Here' s the sequence:

1) Put the tensioner and the spring together before installing them as one to the timing belt cover. Tighten the bolt and the nut to the extent that the tensioner can be moved by hand easily.

NOTE:
When carrying out the above job, make sure to loosen each lock nut and then each valve clearance adjusting screw so that the camshaft and the pulley can rotate freely.

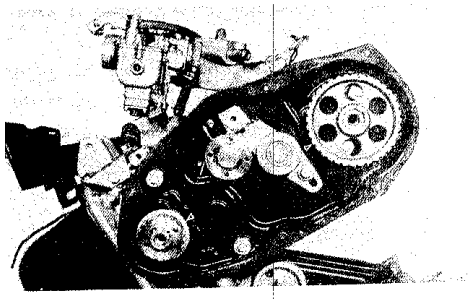


Fig. 3-138

2) Camshaft timing belt pulley has another punch-mark ④, which is located on the radial line passing through the punch-mark ① mentioned above. Now, timing belt inside cover has an embossed mark ⑤ : Turn camshaft timing belt pulley to the position where mark ④ meets mark ⑤.

3) The inside cover has another embossed mark ⑥. Turn crankshaft to match keyway ③ of crankshaft timing belt pulley to mark ⑥.

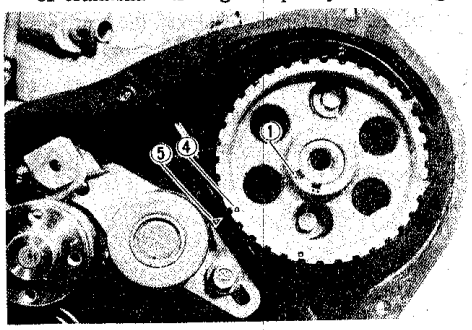


Fig. 3-139

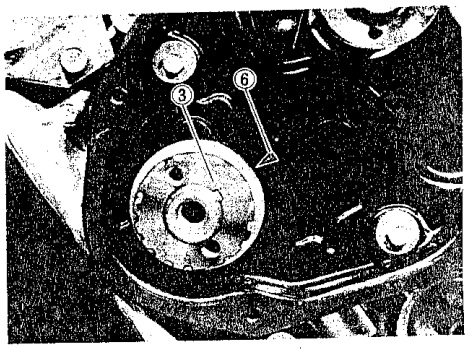


Fig. 3-140

4) You now have the two pulleys correctly related to each other in angular sense. Under this condition, put on the timing belt in such a way that portion of belt indicated as ⑦ is free of any slack.

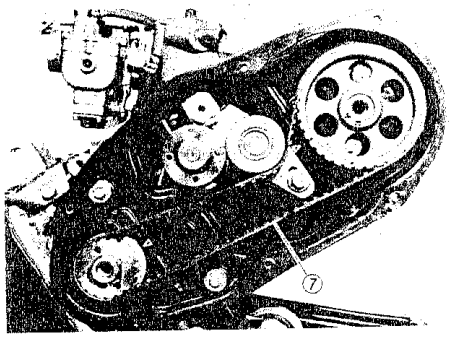


Fig. 3-141

5) After putting the belt, hook the spring on the bracket as shown in Fig. 3-142. The spring, with its own tension, adjusts the belt tension to the specified value.

Rotate the crankshaft clockwise fully twice and tighten the bolt and the nut to the specified torque, after being sure the two pulleys are synchronous.

NOTE:

- Apply THREAD LOCKCEMENT SUPER GY230 Anaerobic bond to the screw part of the tensioner bolt.
- Make sure to tighten the bolt first and then the nut.

Tightening torque for tensioner bolt and nut	N · M	kg-m	lb-ft
	15～23	1.5～2.3	11.0～16.5

CAUTION:

After setting the belt tensioner, turn crankshaft 2 rotations in clockwise direction to see if marks ① ④ ⑤ ⑥ and crankshaft keyway ③ locate themselves on the same straight line. If they do not line up straight, the foregoing procedure must be repeated to satisfy this requirement.

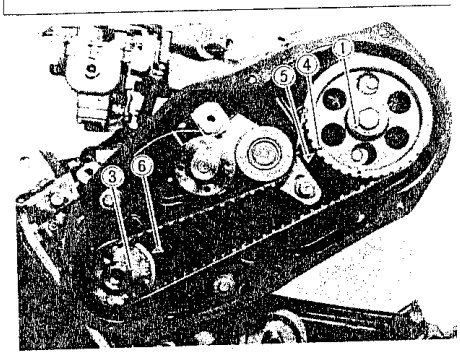


Fig. 3-142

6) Check to be sure that the tension is within the specified range when pushing the belt at the mid point between camshaft and crankshaft.

Timing belt tension "L"	5.5-6.5mm (0.22-0.26in.)

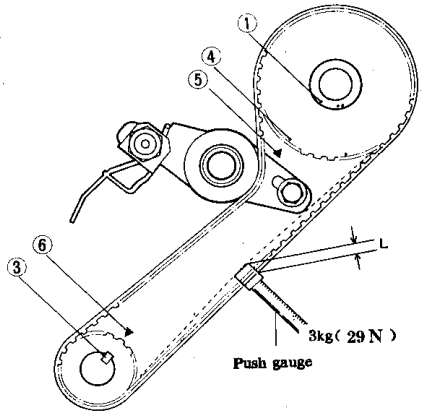


Fig. 3-142-1

7) After adjusting the belt tension within the specified range, adjust each valve clearance to the specified value.

Valve clearance adjustment

The method of valve clearance adjustment is accomplished by means of adjusting screw ⑧. Nut ⑨is for locking the screw. Use a feeler (thickness) gauge to measure the clearance between screw ⑧ and stem ⑩ when the rocker arm arc contacts the base circle of the cam.

Valve clearance specification (when cold)	Intake	0.13-0.18mm (0.005-0.007in.)
	Exhaust	

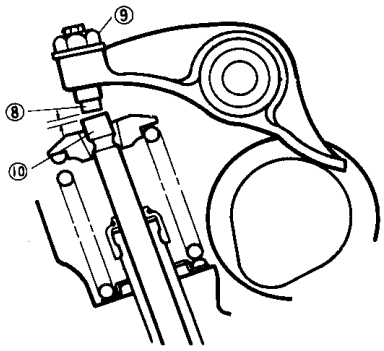


Fig. 3-143

If the engine has been disassembled, it is absolutely necessary to check each valve clearance and set it to the specification, as expiained above, upon engine reassembly.

CAUTION:
When checking the valve clearance, be sure that the rocker arm arc is off the camshaft cam (and contacts the base circle of the cam.) The clearance reading is meaningless if the arm is riding on the cam. Stick to this rule for each valve.

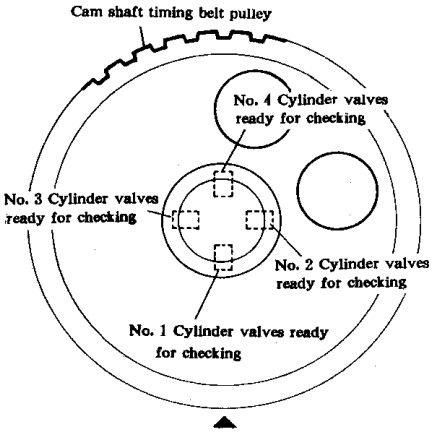


Fig. 3-144

Distributor gear case

Bolts ① are for securing this distributor seat to the cylinder block. When installing the case, be sure to apply Anaerobic bond QY168 to the threads of these bolts.

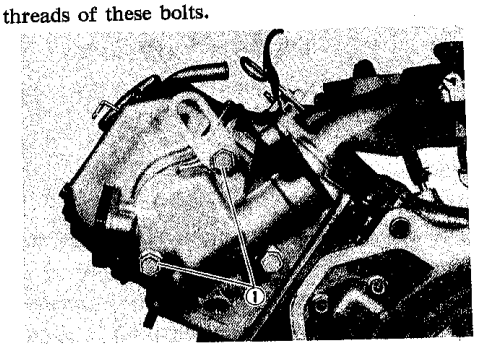


Fig. 3-145

Distributor

The distributor takes its mounted position correctly only when it is inserted into the distributor seat under a specific condition. The condition is this: Turn over crankshaft to locate the piston at B. T. D. C. 10° (No. 1 Piston being compression stroke), and insert the distributor into the distributor seat, with center ② of distributor rotor lined up with embossed mark ③ of distributor housing, as shown in Fig. 3-146.

NOTE:
For the checking and adjusting steps on ignition timing, refer to the section dealing with the ignition system.

CAUTION:
Where the distributor seat has heen removed, it is necessary to fill in 60 cc (2. 03/2. 11 US/Imp oz) of engine oil after re-installing the gear case.
Pour this much oil in through the distributor mounting hole. The gear could develop trouble if this step is ignored.

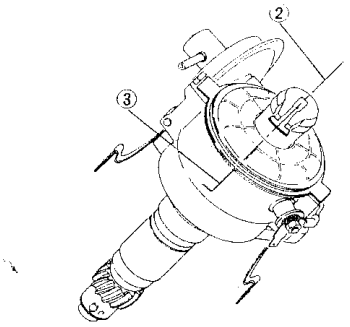


Fig. 3-146

Alternator

The water pump drive belt, by which the alternator too is driven, must be tensioned to the specification after the alternator is installed. Check the tension at the middle point of the belt between water pump pulley and alternator pulley. To vary the tention for adjustment, displace the alternator in place.

Drive belt tension (in terms of belt deflection as shown)	10-15mm(0. 4-0. 6in.) under 10kg (22. 0lb) thumb pressure

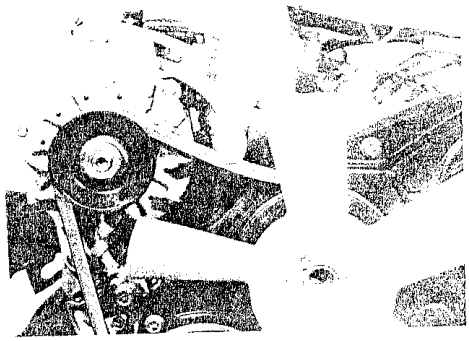


Fig. 3-147

Clutch

At the time of bolting the clutch cover after mounting the clutch disc, the disc must be turned up and centered. Carry out this centering job with the use of the special tool Ⓐ.

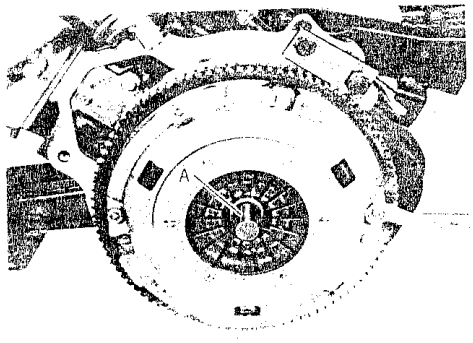


Fig. 3-148

3-7. Engine Inspection and Adjustments

Fan belt

Adjust the belt tension as outlined in the section for ENGINE COOLING SYSTEM.

Distributor point gap

The method of adjusting the contact point gap is described in the section for IGNITION SYSTEM.

Ignition timing

Refer to IGNITION TIMING.

Carburetor

Adjustments to be made are detailed in CARBURETOR.

Valve clearance

Valve clearance specification (COLD)	Intake	0.13-0.18mm (0.005-0.007in.)
	Exhaust	

To check and adjust valve clearance with the engine mounted in place, that is, secured to the chassis, be sure to remove the cylinder head cover, so that you can take a good look at rocker arms and camshaft. Remember, a clearance reading is meaningful only when it is taken with the rocker arm clear of and not riding on the cam.

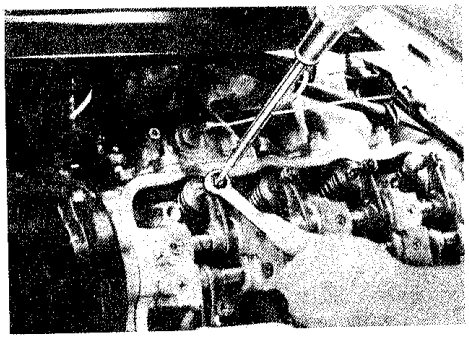


Fig. 3-149 Adjusting valve clearance

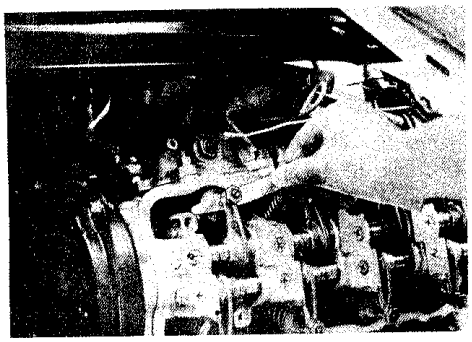


Fig. 3-150 Measuring valve clearance

Timing belt

This belt is an expendable item. Periodically, inspect it for breakage, cracks, wear and cleanliness. If it is badly dirtied with greasy matter or otherwise damaged, replace it.

> NOTE:
> **Inspect the belt for any damage or wear while moving it by turning the crankshaft clockwise.**

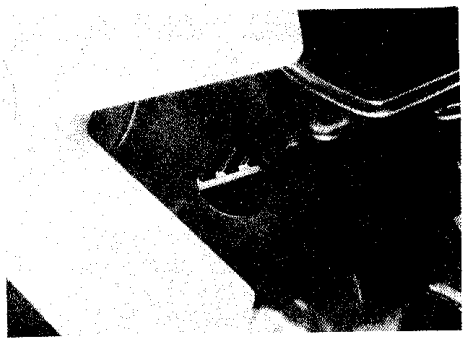


Fig. 3-151

Oil pump discharge pressure measurement

The method of pressure measurement is outlined in the section for ENGINE LUBRICATION.

Compression pressure measurement

Check the compression pressure on all four cylinders, as follows:

1) Remove all spark plugs.

2) Install the compression gauge Ⓐ (09915-

64510) on one of the cylinders, making the connection perfectly air-tight.

3) Disengage the clutch (to lighten starting load on engine), and depress the accelerator all the way to make the throttle full-open.

4) Crank the engine with the starter motor, and read the highest pressure on the compression gauge.

5) Carry out the steps 2) through 4) on each cylinder to obtain four readings.

Compression pressure

Standard	Limit	Difference
11.5kg/cm² (163.5psi) /300r/min	(10.0kg/cm² (128.0psi)/300r/min	1.0kg/cm² (14.2psi)/300r/min between any two cylinders

NOTE:
There is some trouble in the engine when the compression pressure is not higher than the limit. Refer to TROUBLE-SHOOTING GUIDE for possible causes.

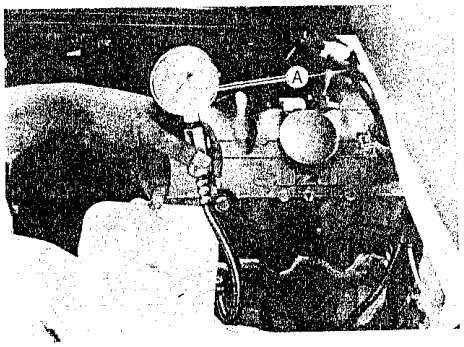


Fig. 3-152

Vacuum measurement

The vacuum that develops in the intake line is a good indicator of the condition of the engine. It is for this reason that the vacuum is measured. The measuring procedure is as follows:

1) Run the engine until its coolant temperature rises to a level between 75℃ and 85℃ (167°F-185°F).

2) Install the vacuum gauge Ⓑ on the manifold as shown in Fig. 3-153. Install an engine tachometer.

3) Run the engine at the specified idling speed and, under this running condition, read the vacuum gauge. The vacuum should be not lower than 40 cm Hg (15.7in. Hg).

A low vacuum reading means that any combination of the following malconditions is the cause, which must be corrected before releasing the machine to the customer:

(a) Leaky cylinder head gasket
(b) Leaky inlet manifold gasket
(c) Leaky valves
(d) Weakened valve springs
(e) Maladjusted valve clearance
(f) Valve timing out of adjustment
(g) Ignition mistimed
(h) Carburetor improperly adjusted

NOTE:
Should the indicating hand of the vacuum gauge oscillate violently, turn the adjusting nut Ⓒ to steady it.

Standard vacuum	45cm Hg Over(17.7in. Hg)
Idling speed specification	900r/min (Take vacuum reading at this speed.)

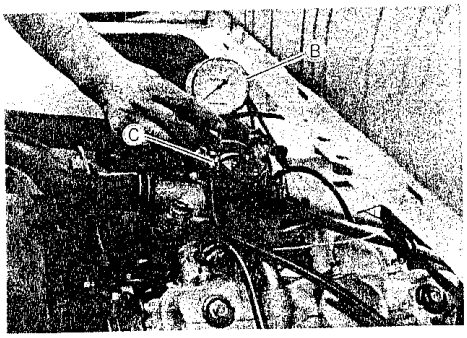


Fig. 3-153

Engine oil

Refer to the section for ENGINE LUBRICATION.

Engine oil filter

The methods of checking and servicing the oil filter are outlined under ENGINE LUBRICATION.

Engine coolant

This subject is covered in the section for ENGINE COOLING SYSTEM.

Exhaust line and muffler

Inspect each exhaust line connection for tightness, and examine the muffler and other parts for evidence of breakage and leakage of gases. Repair or replace defective parts, if any.

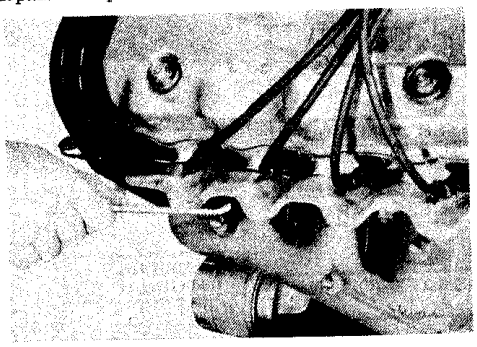


Fig. 3-154
Crankcase ventilation hose

Inspect this hose for cracks and evidence of breakage and, as necessary, replace it. Check to be sure that the hose connection is tight.

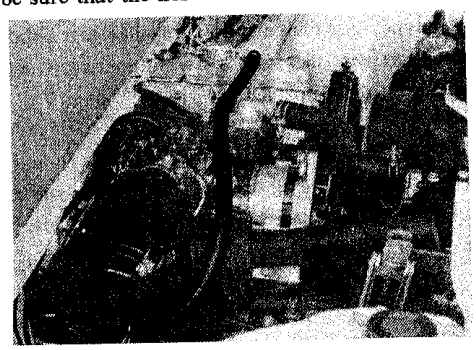


Fig. 3-155

Oil filler cap

The cap has a packing. Be sure that the packing is in good condition, free of any damage and signs of deterioration, and is tight in place; it is replaceable.

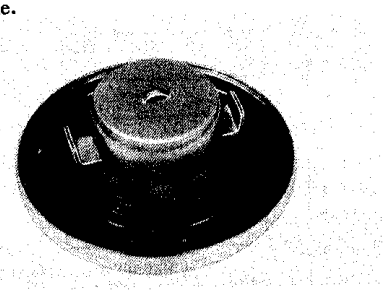


Fig. 3-156

3-8. Engine Lubrication

Description

The oil pump for pressure-feeding lubrication oil to the running parts of the engine is of an internal gear type, in which an outer ring-like gear is internally meshed with an inner gear, there being a separating crescent-like stator between the two. The pump is mounted on the front end of the engine, and is driven by the crankshaft.

Oil Circuit:

The oil pump lifts oil through the strainer and discharges it under pressure, forcing the oil through the oil filter. The filtered oil flows into two paths inside the cylinder block. In one path, oil reaches the crankshaft journal bearings and big-end bearings on crankpins. Some of this oil goes to the connecting-rod small ends and lubricates piston pins there and also the walls of cylinder bores.

In the other path, oil goes up to the cylinder head through the camshaft center journal and enters the internal oilways of rocker arm shafts to lubricate the sliding parts of these shafts and also other four journals of the camshaft.

An oil relief valve is provided on the oil pump. This valve starts relieving oil pressure when the pressure comes over about 4. 5kg/cm^2(64. 0psi). Relieved oil flows back to the oil pan.

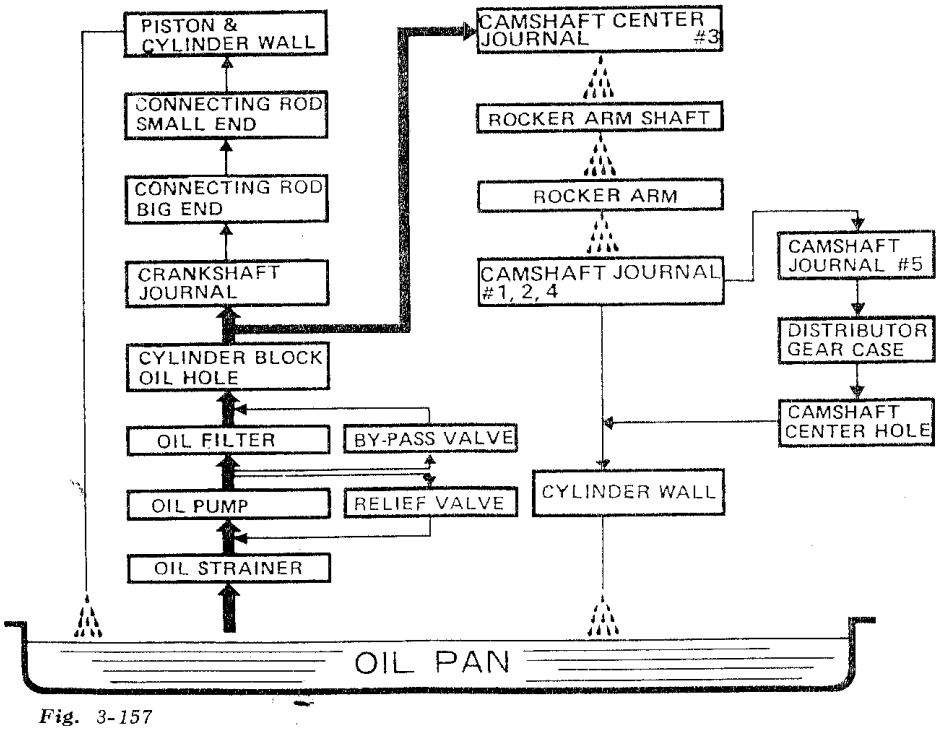


Fig. 3-157

Oil pump disassembly

Remove oil pump gear plate.

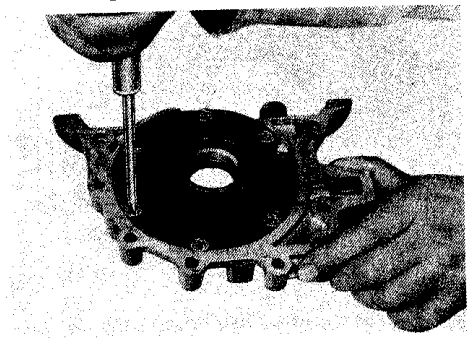


Fig. 3-158

Take out inner gear.

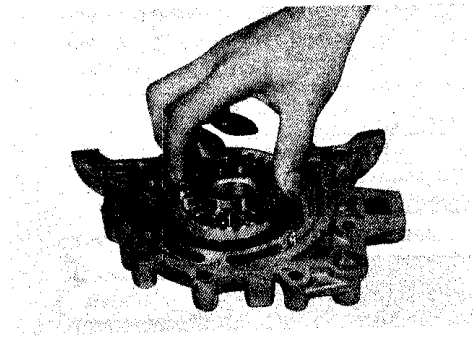


Fig. 3-159

Take out outer gear.

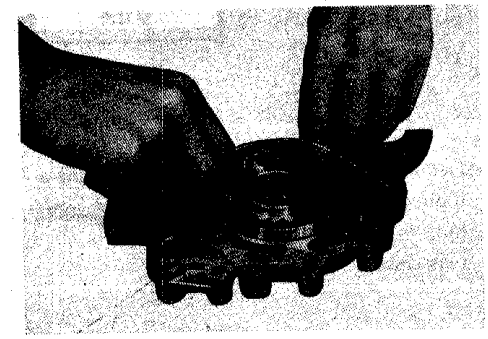


Fig 3-160

Oil pump inspection

Radial clearance between inner gear and crescent.

Standard	0.60-0.80mm (0.0236-0.0315in.)

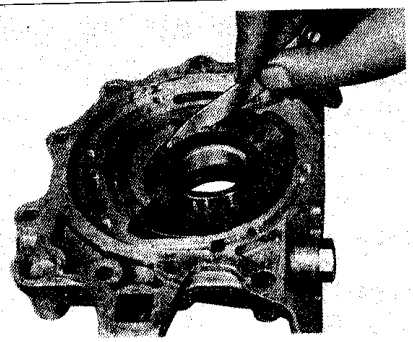


Fig 3-161

Radial clearance between outer gear and crescent.

Standard	0.25-0.40mm (0.0098-0.0157in.)

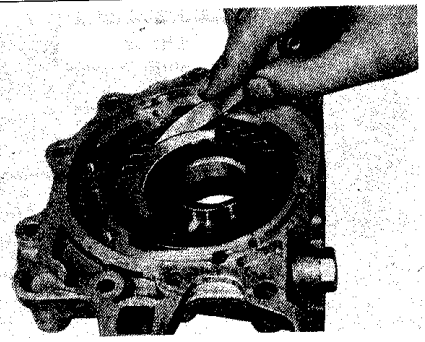


Fig. 3-162

Radial clearance between outer gear and pump case.

Limit	0.3mm(0.0118in.)

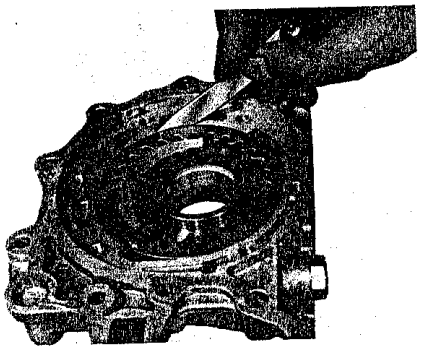


Fig. 3-163

Side clearance:

Using a straightedge, determine the side clearance in terms of the thickness gauge reading taken between straight edge and gear, as shown in Fig. 3-164.

Limit on side clearance	0.17mm (0.0067in.)

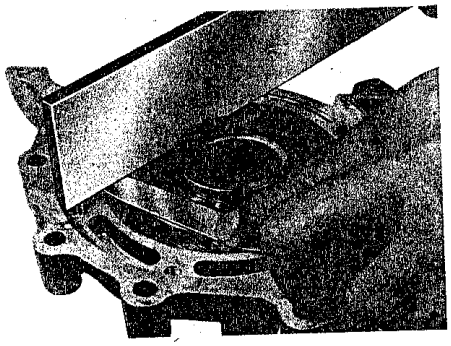


Fig. 3-164

Oil pump reassembly

Have all disassembled parts washed clean, and rebuild the pump to meet each of the following requirements:

- Outer gear has a punch mark ①. Fit outer gear into the pump case, with this punch-mark side coming on plate side.

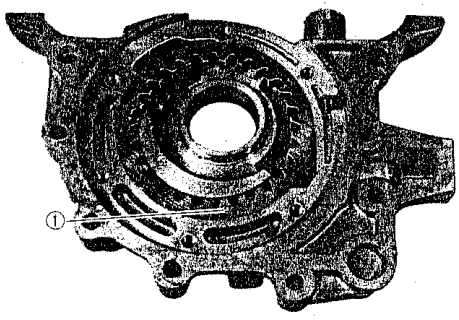


Fig. 3-165

- Use a new gasket when fitting the oil pump case to the cylinder block. The edge of the gasket might bulge out; if it does, cut the bulge off with a sharp knife, making the edge smooth and flush with the end face of the pump case, and apply Anaerobic bond QY168 to the cut edge.

NOTE:
Before fitting the pump case, oil the oil seal lip.

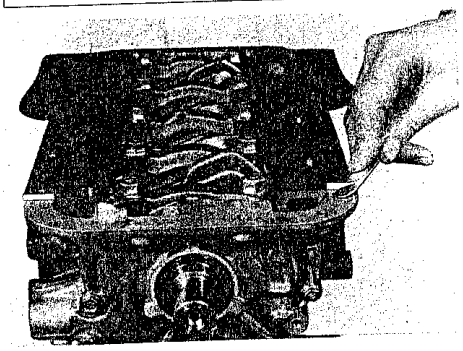


Fig. 3-166

- Installation of crankshaft timing belt pulley and timing belt must be carried out in strict conformity to the special instructions given for engine reassembly.

CAUTION:
Strict adherence to the special instructions is essential, for an improperly installed pulley and timing belt prevents the engine from operating as designed.

Oil filter servicing

At intervals stated below, replace the oil filter element. The element must be replaced not only periodically but also whenever it is found dirty.

Initial replacement to be made:	After 1,000km 62. 2miles
Replace at intervals of:	Every 10,000km (6215miles)

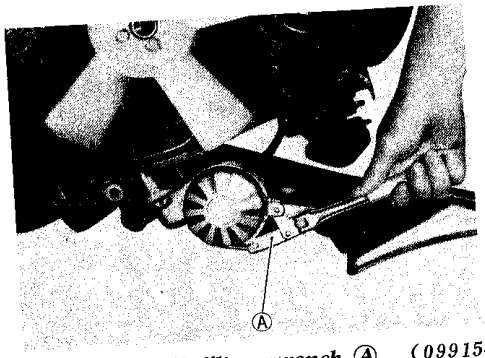


Fig. 3-167 Oil filter wrench Ⓐ (09915-47310)

Oil pump strainer servicing

Inspect the strainer periodically and, as necessary, clean it by washing to remove dirty matters clogging its screen.

Checking the oil pressure

When the engine is idling, not to mention fast running, the oil pressure light should remain completely off; if not, it is a cause for checking the oil pressure in the following manner:

1)Be sure that engine oil is up to level in the oil pan. Refill the oil pan, as necessary, to raise the oil to and above "LOW" line on the level gauge. Be sure, too, that the oil filter is clean and that the oil pump strainer is not clogged. Check to be sure that there is no oil leakage from any part of the engine.

2)Remove the oil pressure unit, which is mounted on that side of the cylinder block where the oil filter is located. Into the vacated threaded hole, screw the pressure gauge connection to install the gauge.

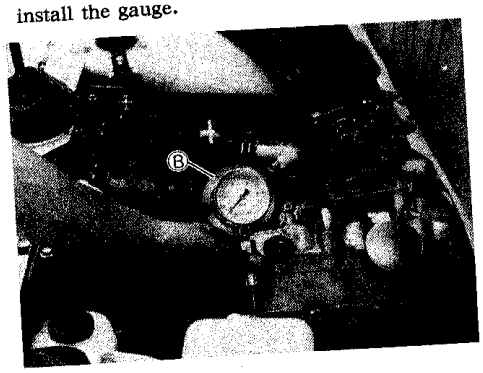


Fig. 3-168

3)Start up the engine and idle it until the coolant temperature rises to a level between 75°and 85℃ (167°-185°F). At this temperature, raise engine speed to 3,000 r/min and read the pressure gauge indication.

Oil pressure specification	3. 0-4. 5kg/cm²(42. 66-63. 99psi) At 3,000r/min (rpm)

If the pressure read is not up to the specification, the oil pump must be checked.

CAUTION:
When re-installing the oil pressure unit, be sure to wrap its screw threads with a sealing tape. Tighten the unit to a torque value of 1. 2 to 1. 5kg-m (9. 0-10. 5lb-ft).

Engine oil servicing

For the engine oil, use API QE Grade

SAE20W/40 engine oil. Each oil change requires this much oil.

Periodical oil change	3L
Filling up after engine overhauling	3. 5L

Oil level:

Refill the engine oil whenever necessary, in order to maintain the oil surface between "LOW" and "FULL" lines on the oil level gauge.

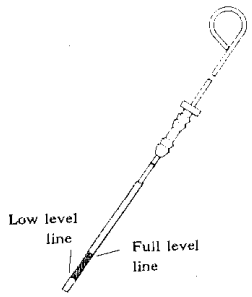


Fig. 3-169 Oil level gauge

4. CARBURETOR

4-1 Description

The carburetor, serving all four cylinders, is of a horizontal-draft Solex type, composed of the following component parts:

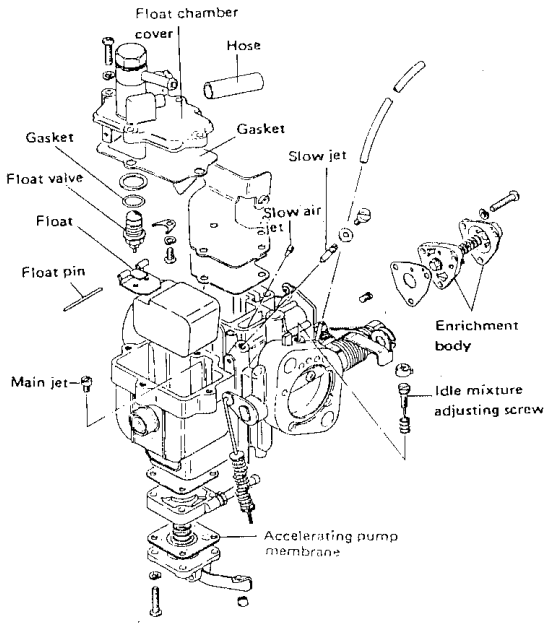


Fig. 4-1

4-2. Carburetor Specifications

Item	Specification
Venturi diameter	25mm(0.984in.)
Main jet	#100
Main air hole	1.1
Slow jet	#52.5
Slow air jet	1.8

4-3. Carburetor Operation

Float chamber

The float chamber with its needle valve is a vessel receiving the fuel from the fuel pump and holding it up to a certain constant level. The float responds to the up-and-down movement of fuel surface and actuates the needle valve.

Slow speed mixture

Referring to Fig. 4-2, fuel flows out of the float chamber through main jet and reaches slow jet. Slow air jet admits air, metering this air and sends it to the inlet side of slow jet, which meters this mixture of fuel and air into the slow circuit terminating at idle port and bypass port.

During idling, the slow speed mixture (coming from slow jet) is sprayed out mainly from idle port and becomes mixed with the air flowing into the main bore. Thus, the air-fuel mixture can be made richer or leaner by re-setting idle adjusting screw in loosening or tightening direction, respectively, in that order.

High speed mixture

Two circuits come into operation for producing the high speed mixture. One circuit begins with main jet, which meters out fuel from the float chamber. This fuel is mixed with the air meteringly admitted by main air hole; this mixing is effected in emulsion tube. The emulsified mixture is then sprayed out into the venturi from main bleed pipe.

The other circuit goes into service when the manifold vacuum falls to move the diaphragm in the enrichment device on the carburetor body. As the diaphragm so moves, the valve above it opens to let out fuel through the hole provided in the chamber. Enrichment jet meters out this fuel and sends it to emulsion tube, from which it flows into main bleed pipe and is sprayed into the venturi.

Acceleration power system

The main device of this system is an accelerating pump for making the carburetor respond without delay to the accelerator pedal depressed abruptly while the engine is running in its low speed range or is idling. The actuating lever of this pump is linked to the throttle shaft so that, as throttle valve opens quickly, the pump lever pushes up the diaphragm, thereby closing suction ball valve and opening discharge ball valve. Consequently, the fuel in the pump is forced out of pump nozzle into the venturi.

Others

A fuel return circuit is provided in this carburetor in order to avoid "vapor locking" of fuel. How "vapor locking" is avoided will be explained: When the fuel level rises in the float chamber, its float valve closes; and, as the level falls, the valve opens. With the valve closed, the incoming fuel (delivered under pressure by the pump) finds its way through the sidewise hole provided in the top part of the float valve anchoring point and flows throuth the passage drilled out through the float chamber wall and provided in the section under the acceleration pump to the fuel tank filler. This arrangement allows the fuel pump to keep on delivering fuel. For this reason, the incoming fuel for the float chamber is always "cold" and cools the float chamber and acceleration-pump chamber by flowing past its chamber, thereby suppressing the conditions leading to vapor locking.

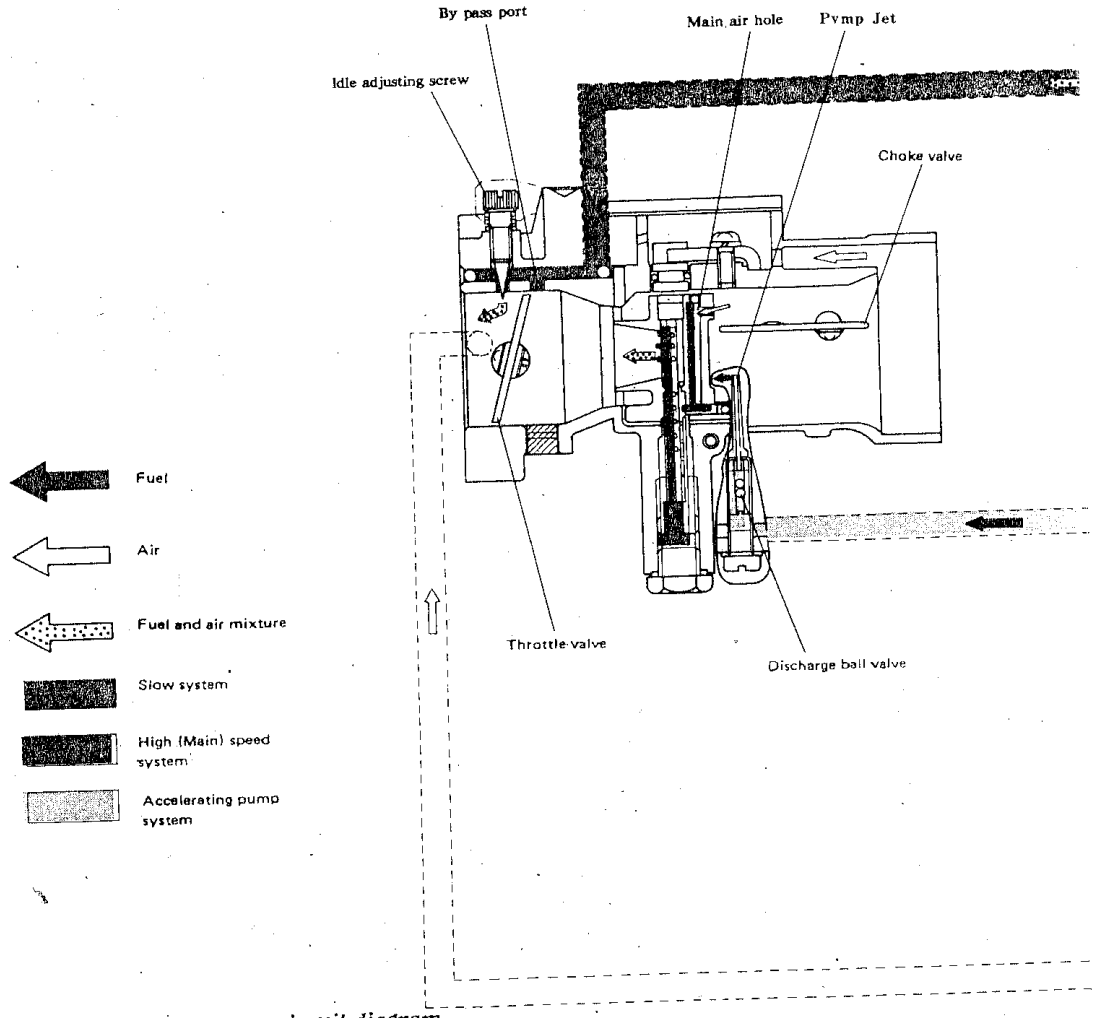
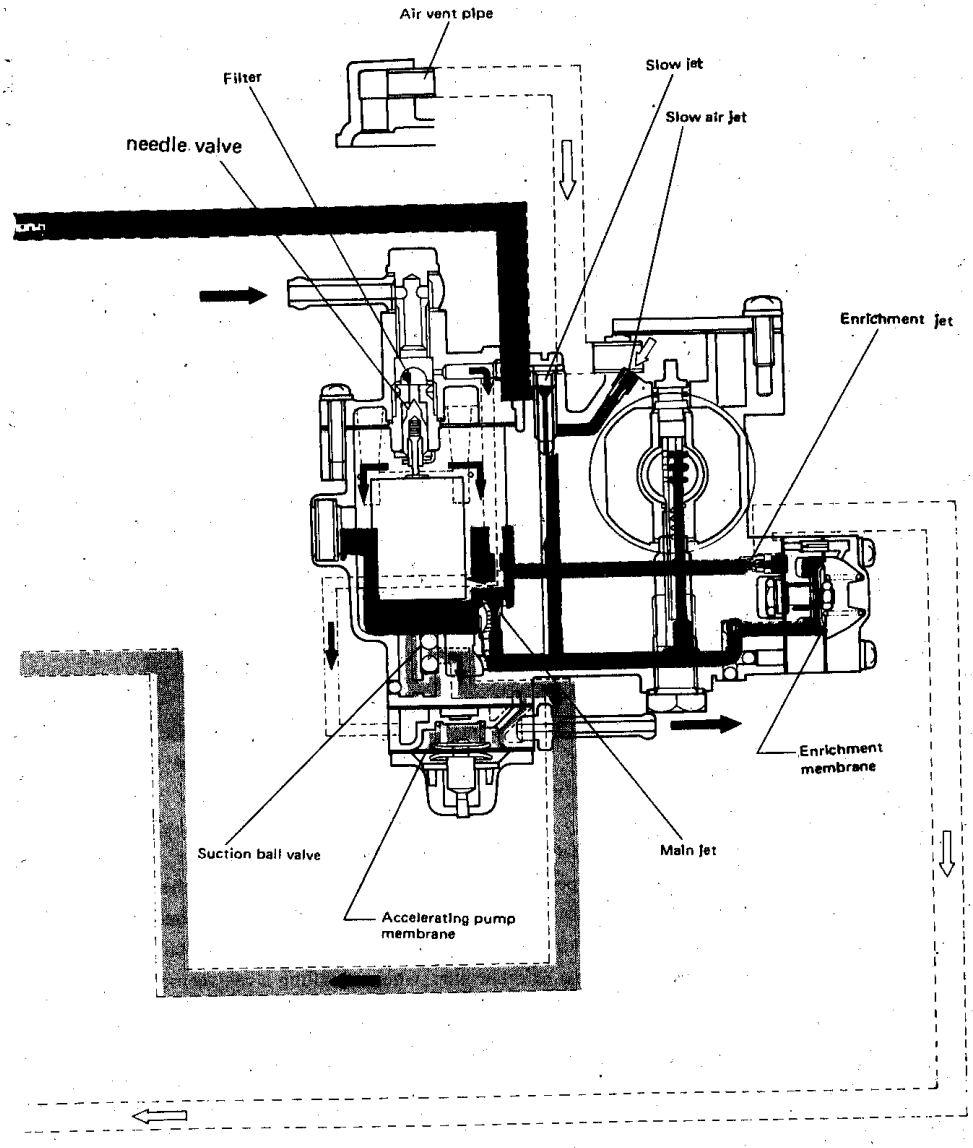


Fig. 4-2 Carburetor circuit diagram



4-4. Inspecting and Adjusting

Jets

Wash the jets clean. Wash the holes in which jets are located, and clear each hole by directing compressed air to it.

A clogged slow jet is usually responsible for erratic engine idling. Erratic engine operation in the medium and high-speed ranges and during acceleration is often accounted for by a clogged

condition of main jet, main air hole or hole constrictions in the carburetor body.

Fig. 4-3

Needle valve

The conical tip of needle valve is subject to wear as this tip seats and unseats in the normal operation of the needle valve. When the needle valve is in closed condition, this tip is pushed against the seat by the float.

Inspect the conical tip and seat for evidence of clogging. As necessary, remove the seat and wash it clean. A worn needle, illustrated in Fig. 4-4, must be replaced. Remember, a clogged or poorly seating needle valve is usually accountable for "overflow".

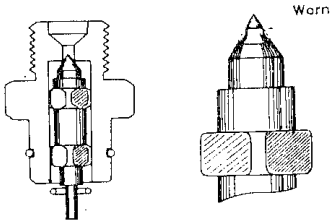


Fig. 4-4

Choke valve

Check to be sure that, when the choke knob is pulled out all the way, the shaft of choke valve in the carburetor will rotate, and that, when the knob is pushed in , the shaft will rotate back to original position.

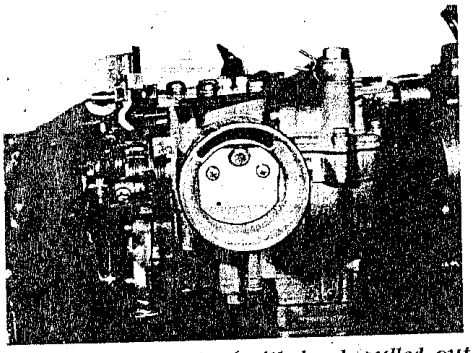


Fig. 4-5 Choke valve (with knob pulled out fully)

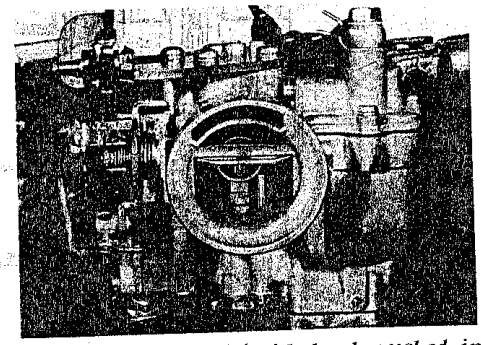


Fig. 4-6Choke valve (with knob pushed in fully)

Accelerator and choke cables

Inspect these cables for wear and tear, and check to be sure that each cable connection is in sound condition. Do not hesitate to replace a defective cable or other part; when installing a replacement cable, tighten the connections good and hard.

NOTE:
Install the choke cable to the carburetor body with the choke knob pulled out about 7 mm(0. 27in). If this is not done, the choke valve may not return completely to the original position.

Fig. 4-7

Fuel hose

Inspect the hose for cracks and signs of breakage, and replace it as necessary. Examine it for signs of leakage, too. Be sure that the hose is free of any leak and that its connections are tight.

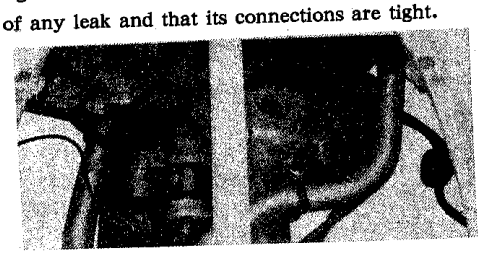


Fig. 4-8

Fuel tank cap

This cap is fitted with a rubber packing. Be sure that the packing is in good condition and that the cap in place is tight and leak-free.

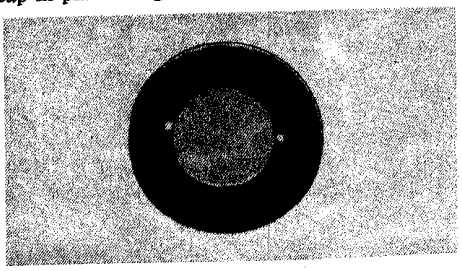


Fig. 4-9

Idle speed and idle mixture adjustment

NOTE:
Requires external tachometer.

As preliminary steps, check to be sure that:

- Coolant temperature is approximately 82℃ (180℉).
- Choke valve is in the full-open position.
- All accessories (wipers, heater, lights, etc.) are out of service.
- The ignition timing is within specification.
- The air cleaner has been properly installed and is in good condition.

[Idle speed and idle mixture adjustment]

Adjust idle speed by repositioning the idle speed adjusting screw①, making sure the engine idles steady at 900 r/min (rpm)±50r/min(rpm).

Idle mixture adjusting screw② generally needs no adjustment. However, when the adjusting screw is removed to overhaul the carburetor, adjustment is necessary as follows:

Tighten idle mixture adjusting screw ② fully and; gradually untightening it, set the screw at a position where the engine speed is the highest (best idle). Then, readjust the engine idling speed to 900 r/min (rpm) with idle speed adjusting screw ①.

CAUTION:
- **When cars are used in countries where exhaust gas regulations are in force, check the exhaust gas with an exhaust gas tester. If gas exceeds the value specified in the regulations, adjust the idle mixture adjusting screw②.**

For European market, adjust the screw② with special tool.

For other market, adjust the screw ② with plain screwdriver.

Engine idling speed specification	900±50r/min(rpm)

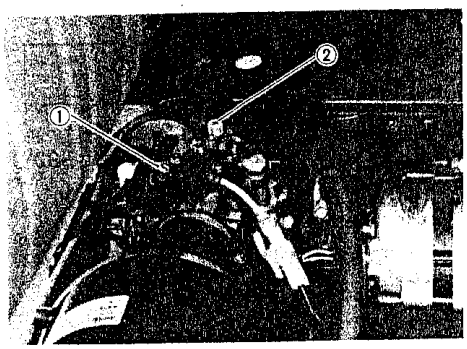


Fig. 4-10

5. AIR CLEANER, CYCLONE, FUEL PUMP AND FUEL FILTER

5-1 Air Cleaner

Description

This air cleaner element is of dry type. Remember that it needs cleaning according to the following method and interval.

1) Take out the cleaner element ① off the air cleaner case.

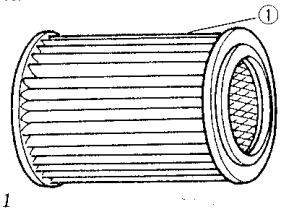


Fig. 5-1

2) Blow off dust by compressed air from inside of element.

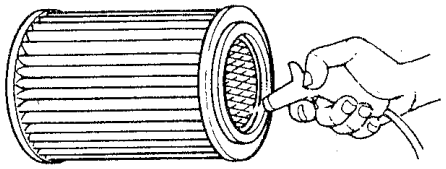


Fig. 5-2

NOTE:
If the element are heavily dirtied, wash it in household type detergent. After washing, rinse the detergent out of element, and dry it completely.

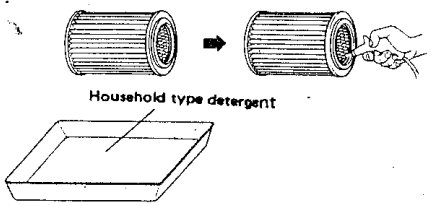


Fig. 5-3

Clean	Paved-road: Every 10,000km (6215 miles)
	Dusty condition: Every 2,500 km (1,553 miles) or as required
Replace	Every 40,000km (24,855 miles) NOTE: More frequent replacement if under dusty driving conditions.

Use of the selector lever (Option)

A mispositioned selector lever can cause the carburetor to get "iced" in freezing weather or the engine to overheat in hot weather. Position this lever according to the atmospheric temperature, i. e, in WINTER position when outside temperature is 15℃ (59℉) or below, or in SUMMER position when the temperature is above that level.

Warm-air selector lever position	
Atmospheric temperature	Lever position
15℃ (59℉) or below	WINTER
Above 15℃ (59℉)	SUMMER

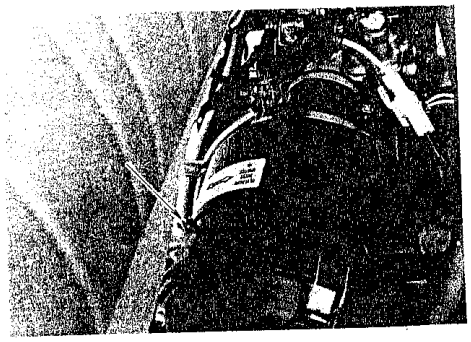


Fig. 5-4

5-2. Cyclone System

(This system device is installed in the vehicles used in certain dusty areas.)

Description

Cyclone is installed in front of the air cleaner inlet hose. Its purpose is to clean the air to be drawn into the air cleaner and the carburetor. It whirls the ingoing air and separates dust out of air with an effect of the centrifugal force produced in it.

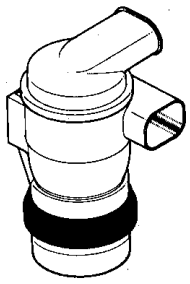


Fig. 5-5

Construction

The air is drawn into No. 1 chamber of Cyclone due to the suction negative pressure of the engine and enters No. 2 chamber through the holes of Plates① which are shaped like the fliers of a windmill. As the air passes, Plates ① give whirling motion to it. The centrifugal force which is produced by the whirling air current presses dust in the air against the inside wall of No. 2 chamber. Dust then drops down into cup ②along the wall. The air free from dust now is drawn into the air cleaner through No. 3 chamber.

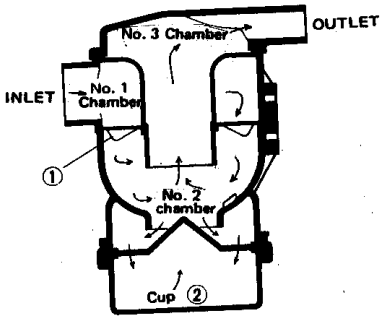
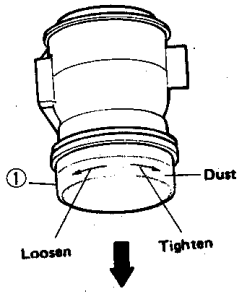


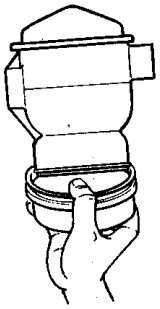
Fig. 5-6

Inspection and cleaning

Check the inside of cup① for dust every month. If dust collects up to the middle of the cup, remove the cup from cyclone, and clean the inside of cup.

Clean	Every month





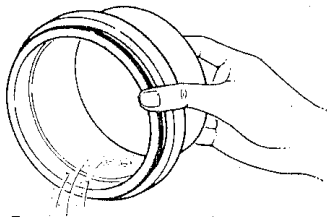


Fig. 5-7

5-3. Fuel Pump

Description

A pneumatic diaphragm pump is used to deliver gasoline to the float chamber in the carburetor. Its diaphragm is actuated from one of the cams formed of engine camshaft. A rocker arm rides on this cam and moves the pump diaphragm up and down.

Fuel pump specifications	
Discharge pressure	0.25-0.35 kg/cm² (3.55-4.97psi)
Pump capacity	1.3litres/minute or better at 2,000 r/min

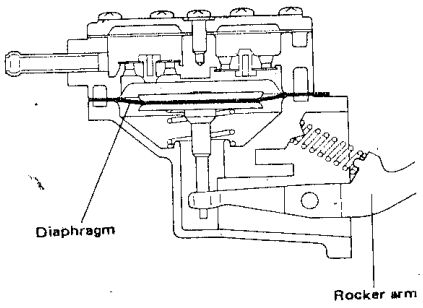


Fig. 5-8

Important pump disassembling step

Scribe match marks①across the joint seams to establish and identify the angular positions of upper half② and lower half ③ as shown in Fig. 5-8. This provision is necessary because the screw holes are so located as to permit the two halves to be angularly positioned in more than one way, whereas the pump can be piped only when the pump is assembled as shown.

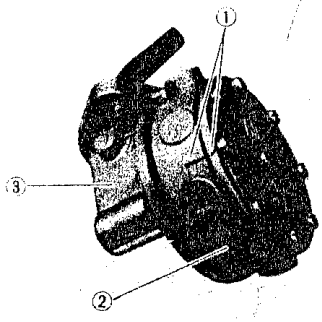


Fig. 5-9

Inspection

- Inspect the fuel pump in place for leakage.
- Be sure that the fuel hose is free of any sign of cracking.
- Be sure that the nuts securing the pump in place are tight.
- After disassembling the pump, examine the diaphragm to be sure it is in good condition, free of any evidence or rupture or breakage.

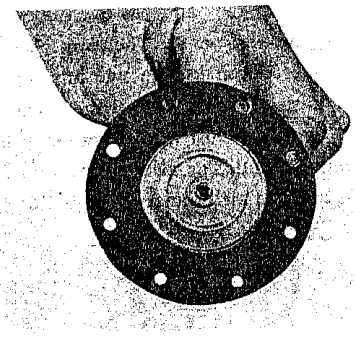


Fig. 5-10

Important pump reassembling

Be sure to fit the upper half and lower half as

guided by the match marks① given at the time of disassembly. With two halves②③ correctly positioned, run in the screws and tighten them equally.

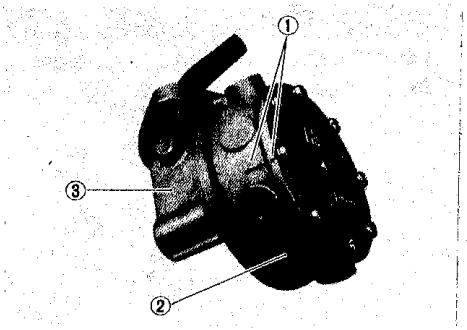


Fig. 5-10

5-4. Fuel Filter

Description

Fuel enters the filter through its inlet hole and, after passing through the filtering element, comes out of its outlet hole communicated to the fuel pump. This filter is not meant to be disassembled. It is of cartridge type, consisting of a filtering element in a plastic case.

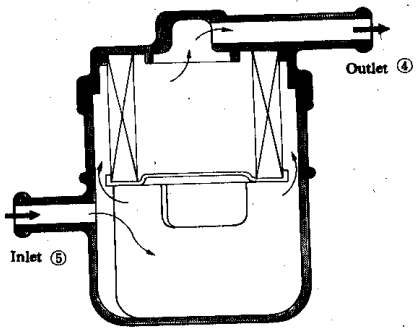


Fig. 5-11

Servicing and installation

As said before, this filter does not permit disassembly; it is to be replaced by a new one periodically. It is one of the expendable items.

Interval of fuel filter replacement	Every 40,000km (24855 miles)

CAUTION:

Fig. 5-11, Left, shows the fuel filter in its correct posture, with outlet④ coming on top side and inlet⑤ on bottom side.

Remember the relative positions of inlet and outlet when piping the filter.

6. ENGINE COOLING SYSTEM

6-1. Description

The engine is cooled by coolant set in forced recirculation through jackets formed in the engine body and through the radiator. For the water pump, a high-capacity centrifugal pump is used. For the radiator, a tube-and-fin type, large in heat dissipating capacity, is used.

The thermostat is of wax pellet type, accurately responsive to temperature changes and durable in construction. It maintains the coolant temperature within a narrow range during operation.

6-2. Cooling Water Circuit

The thermostat remains in closed condition-its valve is closed-when the coolant is cold. Under this condition, the coolant being pumped flows through the circuit comprising cylinder block, cylinder head, inlet manifold, bypass hose and water pump, in that order.

As the temperature rises to 82℃ (179℉) or thereabout, the thermostat begins to open, thereby allowing some of the coolant in recirculation to flow through the radiator. At about 95℃ (203℉) of rising coolant temperature, the thermostat becomes completely open so that little or no flow occurs through the bypass hose; the coolant now flow through the radiator and back to the pump, releasing the most of heat to the atmosphere through the radiator core.

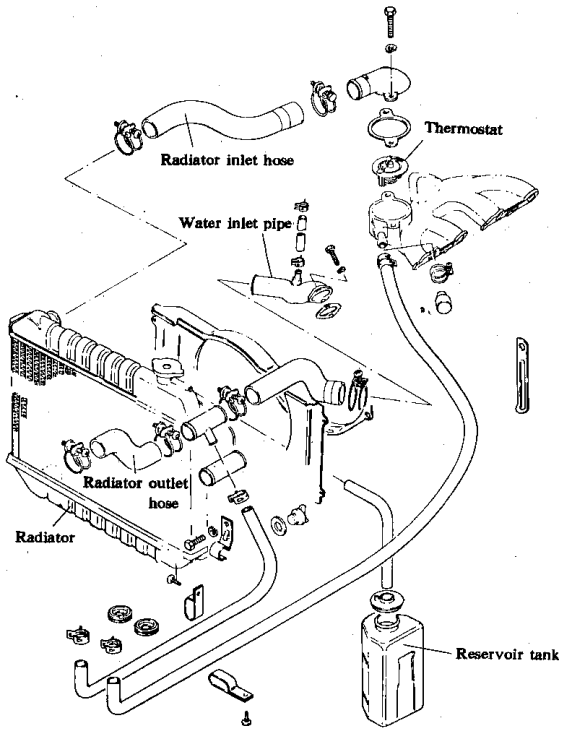


Fig. 6-1

6-3. Removal

1. Coolant draining

1) Loosen the drain plug ① on the radiator to empty its water side.

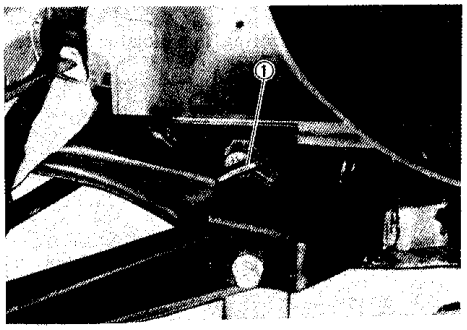


Fig. 6-2

2)The drain plug②for engine water jackets is located below the exhaust manifold. To change the coolant, or to drain the jackets for one reason or another, loosen this plug, too.

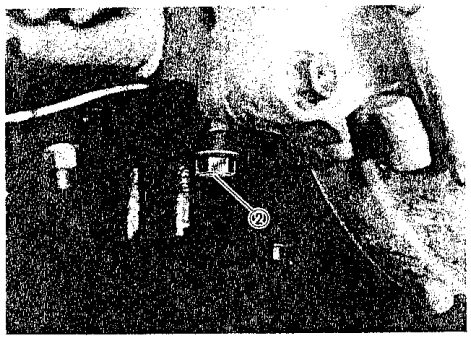


Fig. 6-3

2. Removal of cooling water hoses

To remove these hoses, loosen the screw on each hose clip and pull the hoses end off.

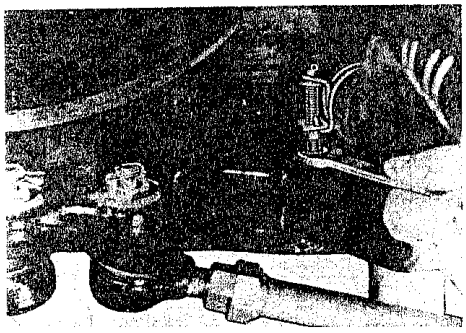


Fig. 6-4

3. Radiator removal

Loosen the bolts securing the radiator in place. Take down the radiator.

Fig. 6-5

4. Cooling fan removal

Removing the bolts securing the fan to the hub allows the fan to be detached.

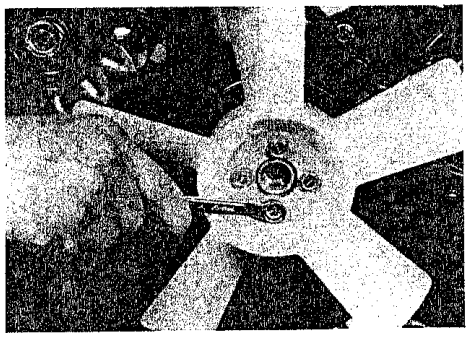


Fig. 6-6

5. Water pump removal

In order to remove the water pump, it is not necessary to take down the engine. The method of removal is sequentially illustrated in Figs. 3-12, 3-13, 3-15, 3-16, 3-17, 3-18, 3-19, 3-20, 3-21 and 3-23.

In these figures, cautioning reminders are given. Be sure to pay attention to those reminders when removing the pump.

The method of re-installing the pump is sequentially illustrated in Figs. 3-136, 3-137, 3-139, 3-140, 3-141, 3-142 and 3-143.

6-4. Functional Description of Major Components

Water reservoir tank

This reservoir, a small plastic tank, is so located relative to, and so associated with the radiator that it receives the excess coolant that would otherwise spill out by overflowing. The excess is due to coolant expansion caused by temperature rise. When the coolant cools down, its volume contracts, and the coolant in the reservoir returns to the radiator.

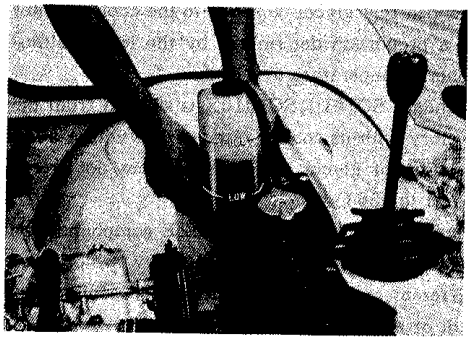


Fig. 6-7

Thermostat

The temperature-sensitive material in the thermostat is a wax pellet. It is hermetically contained in a metal case, and expands and contracts according as the coolant temperature rises and falls. When it expands, the case pushes down the valve to open it.

If, during operation, the valve is suspected of remaining closed while it is expected to open increasingly, the cause is most likely a ruptured wax case.

In the top portion of the thermostat, an air bleed hole is provided; this hole is for venting out the gas or air, if any, that has accumulated in the coolant circuit.

Thermostat functional specifications	
Temperature at which valve begins to open	82℃(179℉)
Temperature at which valve becomes full open	95℃(203℉)

Thermostat functional specifications	
Valve lift	8mm(0. 31in.)

Thermostat

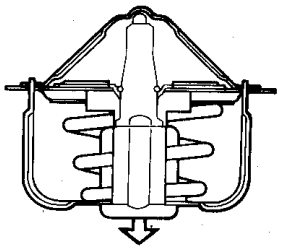


Fig. 6-8

Radiator filler cap

This cap has two built-in valves and, by these valves, allows the internal pressure of coolant circuit to rise to a certain level slightly above that of the atmosphere.

Of the two built-in valves, one is an adjusting valve and the other is a negative-pressure valve. The former opens only when the internal pressure rises by 0. 9kg/cm². This means that the coolant's boiling temperature is substantially above 100℃(212℉)-if the coolant is straight water — and that, under normal running condition, no boiling occurs.

Following a shutting down of the engine, the coolant will cool off and the internal pressure will drop. If the pressure should be allowed to keep on falling, there happens the danger of coolant pipes and radiator cores becoming subjected to a large collapsing pressure; the pipes or radiator cores or any weakest point might give in. The negative-pressure valve opens in such a case to admit atmospheric pressure into the coolant circuit, thereby avoiding a build-up of negative pressure.

The cap has its face marked"0. 9", which means that its pressure adjusting valve opens at 0. 9km/cm².

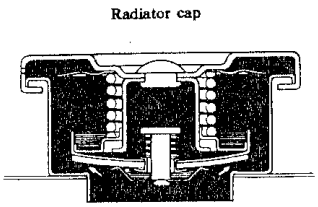


Fig. 6-9

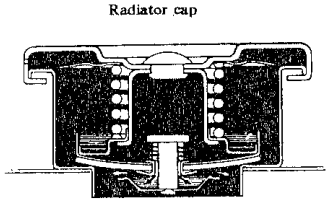


Fig. 6-10

Water pump

The pump rotor is supported by a totally sealed bearing and do not permit disassembly. For this reason, the pump must be replaced by a new one when any part of it has developed a malcondition.

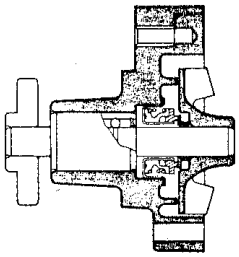


Fig. 6-11

Requirements on coolant

The long-term reliability and cooling capacity of the engine cooling system depends much on the quality of cooling water used. "Hard water", if used, will foul up the cooling circuit by scale formation, for such water is usually high in silicate and mineral contents. Scales are poor heat conductors.

Use of water high in acid concentration is just as bad; such water promotes rusting. For similar reasons, river water, well water, not to mention sea water, are not fit as engine cooling water.

Tap water available from city water supply is the best available water. Distilled water is ideal but is a luxury in most cases.

For protection of the cooling circuit, it is recommended that glycol be added to the cooling water in a proportion determined by the lowest atmospheric temperature expected.

Standard SC1010, SC1010X is shipped from the factory with its cooling circuit filled with a 50% solution of glycol, this solution does not freeze down to -36℃.

Many brands of ANTI-FREEZE compounds are sold in the market. In no case, allow two or more different brands to be mixed in the cooling circuit of the engine.

"GLYCOL Coolant" — "Anti-freeze and Summer Coolant" — its effects and use

(1) Effects of glycol coolant

(a) Its freezing temperature is much lower and depends on the concentration of glycol. It is an anti-freeze coolant.

(b) It does not corrode the metal surfaces of the cooling circuit. It is an anti-corrosion coolant.

(c) It does not develop foam or bubbles. It is a foam-inhibited coolant.

(d) It stands long usage. The renewal intervals is much longer.

(2) How to proportion Anti-freeze coolant to cooling water

Anti-freeze coolant is a multi-purpose anti-freeze compound. Its aqueous solution as engine coolant can be kept in service as long as two years in a single stretch, regardless of changes of season.

To prepare an anti-freeze coolant with Anti-freeze coolant, proportion this compound to

water according to the following chart, in which the proportions are indicated for seven levels of temperature as the lowest expected levels:

ANTI-FREEZE PROPORTIONING CHART

Freezing temperature	℃	−9	−12	−16	−20	−25	−30	−36
	F	16	10	3	−4	−13	−22	−33
Glycol concentration	%	20	25	30	35	40	45	50
Ratio of compound to cooling water	Itr.	0. 90/3. 60	1. 13/3. 37	1. 35/3. 15	1. 57/2. 93	1. 80/2. 70	2. 05/2. 45	2. 25/2. 25
	US pt.	1. 90/7. 60	2. 38/7. 12	2. 85/6. 65	3. 33/6. 17	3. 80/5. 70	4. 28/5. 22	4. 75/4. 75
	Imp. pt.	1. 58/6. 32	1. 98/5. 92	2. 37/5. 53	2. 77/5. 13	3. 16/4. 74	3. 56/4. 34	3. 95/3. 95

NOTE:

Remember, the radiator capacity is 4. 5 litres which includes the reservoir tank capacity of 0. 6 litre (1. 3lb).

Water temperature gauge

This gauge constitutes a system of its own, with an indicator mounted in the instrument panel, an engine unit or sensor of thermistor type and a regulator for passing a constant current. These three are connected as shown in the diagram below:

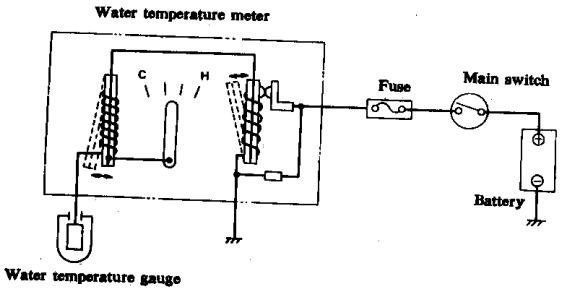


Fig. 6-13

The indicator is of bimetal type; its bimetal element is wrapped with a heater coil and becomes heated by the current flowing in the coil. By deflecting, the element actuates the indicating hand, making the hand move along the temperature scale.

The magnitude of the current is determined by the state of the thermistor in the engine unit. This unit is installed on the intake manifold. Speaking generally, a thermistor is a semiconductor resistive element whose ohmic resistance decreases as its temperature rises; its resistance has a negative temperature coefficient. When the coolant temperature rises, the thermistor offers a decreasing resistance, so that the current increases, thereby deflecting the indicating hand wider. The regulator is a means of maintaining a constant current in the circuit for each ohmic resistance state of the thermistor, and does so function under the varying voltage condition of the battery.

6-5. Cooling System Services

Thermostat

If the thermostat valve is suspected of malfunctioning, check first the possibility of some foreign

matters being stuck on the valve seat to prevent the valve from seating tight. Next, check the thermostatic movement of the wax element in the following manner:

Heat water in a pan by placing the pan on a stove, as shown in Fig. 6-14. Grip the end of a thread or small string by pinching it in the valve and suspend the thermostat unit by holding the other end of the thread or string. Immerse it in the water, holding it about 20 mm (0. 78in) above the bottom, and read the water temperature on the column thermometer.

If the suspended unit falls to the bottom just when the temperature rises to 82℃ (179℉) or thereabout (which is the temperature at which the valve should begin to open), the thermostat unit may be deemed to be in sound condition.

If the valve begins to open at a temperature substantially below or above, the thermostat unit should be replaced by a new one. Such a unit, if re-used, will bring about overcooling or overheating tendency.

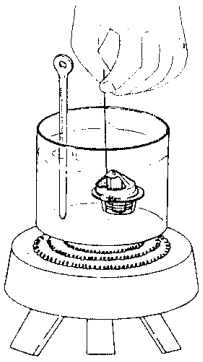


Fig. 6-14

Make sure that the air bleed hole of the thermostat is clear, no clogged.

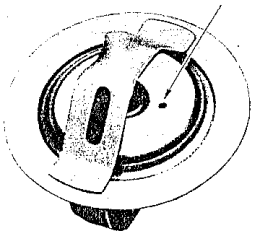


Fig. 6-15

Fan belt

This belt drives both alternator and water pump. Check the belt for tension. The belt is in proper tension when a thumb pressure (*10*kg) applied to the middle point of its span deflects it about *10-15*mm (*0. 4-0. 6*in.). Inspect the belt for signs of deterioration and replace it as necessary.

Belt tension specification	*10-15*mm (*0. 4-0. 6*in.) as deflection

NOTE:
When replacing the belt with a new one, adjust belt tension to 8-10mm (0. 3-0. 4 in.)

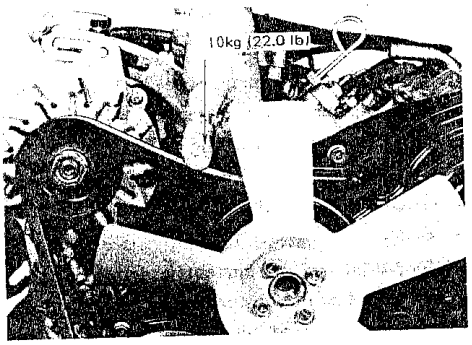


Fig. 6-16

To adjust the belt for proper tension, loosen the 3 bolts securing the generator in place, and displace it to slacken or tighten the belt.

A loose belt, or a belt tending to break off or otherwise defective, is often the cause of engine overheating. Because of the importance of this belt, it is strongly recommended that the belt be replaced at regular intervals even when the belt looks satisfactory in appearance.

Belt replacement interval	Two years (recommended)

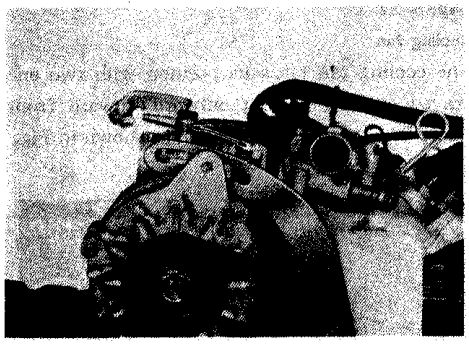


Fig. 6-17

Radiator

If the water side of the radiator is found excessively rusted or covered with scales, clean it by flushing with the radiator cleaner compound. This flushing should be carried out at regular intervals for scale or rust formation advances with time even where a recommended type of coolant is used. Periodical flushing will prove more economical. Excessive rust or scale will lower the cooling efficiency

Inspect the radiator cores and straighten the flattened or bent fins, if any. Clean the cores, removing road grimes and trashes.

Flattened or bent fins obstruct the flow of air through the core to impede heat dissipation.

Radiator flushing interval	Two years (recommended)

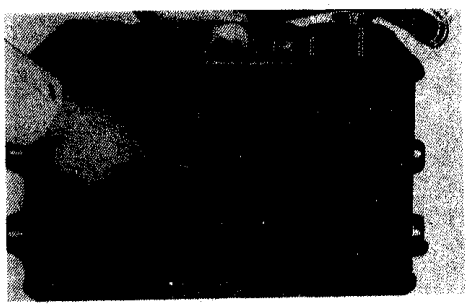


Fig. 6-18

Coolant level

Cooling water in service decreases its volume gradually on account of progressive loss due to water evaporation. Check to be sure that the water surface is up to anywhere between FULL and LOW marks on the reservoir tank. The user should be reminded of the need to daily check the water level.

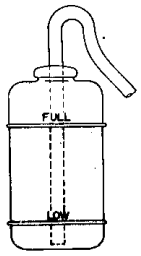


Fig. 6-19

Water hoses

Inspect each water hose for evidence of cracking or breakage, and be sure that its connection is tight. A defective hose or a hose showing signs of malcondition must be replaced. Tighten the hose connections as necessary.

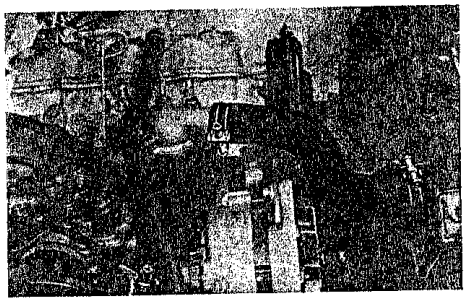


Fig. 6-20

6-6. Important Reinstalling Steps

Filling up the cooling system

Park the machine on a flat level floor, and fill in until you see the coolant come up to the well part of the radiator filler. Then, run the engine two or three minutes to recirculate the coolant. This recirculation will drive out air, if any, trapped inside, and will lower the coolant surface at the filler. Add coolant until its surface shows up again in the filler, and fill up the reservoir tank, raising the surface to FULL mark.

> **NOTE:**
> Check to ensure that there is a clearance of 10mm(0. 4in.)between the end of the rubber hose in the reservoir tank and the bottom of the tank.

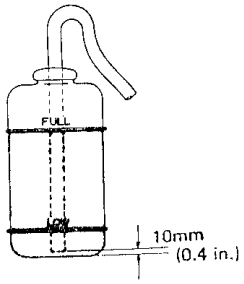


Fig. 6-21

Cooling fan

The cooling fan takes its position with two engraved cylinders facing outward (toward front side). Be sure to mount the fan as shown in Fig. 6-22.

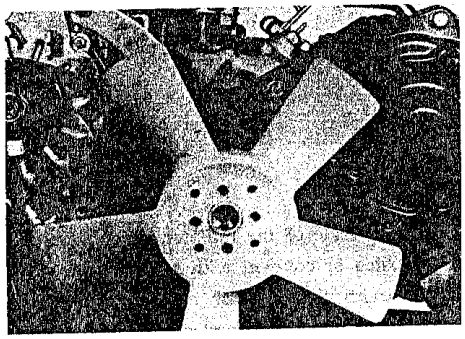


Fig. 6-22

7. CAR HEATER(optional)

7-1. Description

The optional car heater is of hot water type. Its operation is quiet. It takes engine heat through the medium of water and sends warm air into the room by means of a blower.

Since the blower drive is electrical, independent of engine speed, the heater is just as effective even when the engine is running slowly. In summer, the blower doubles as a fan for room ventilation, with the heater valve kept closed.

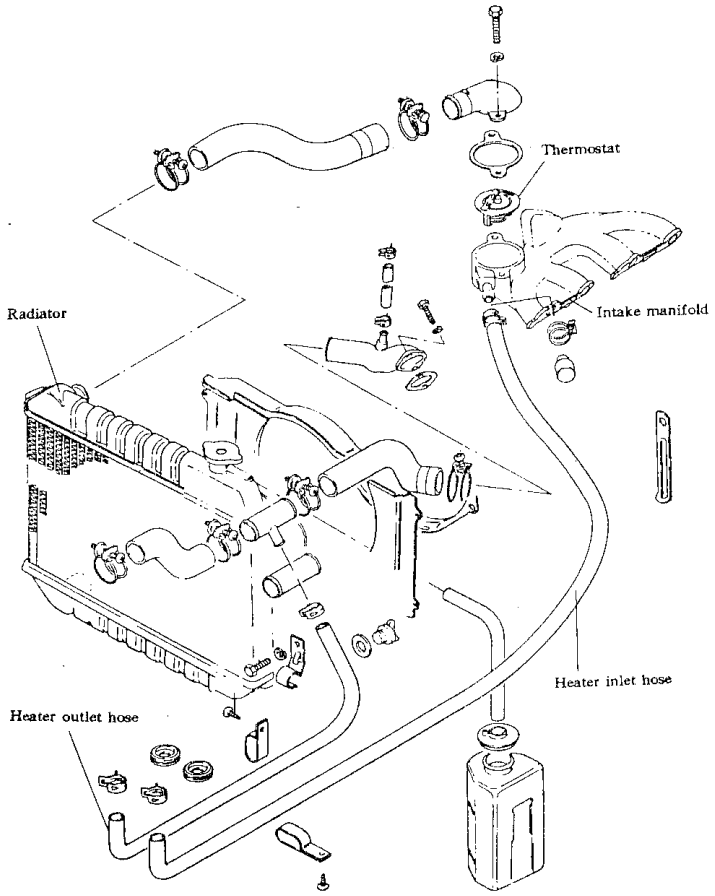


Fig. 7-1

7-2. Electrical Circuit

The circuit diagram shown in Fig. 7-2 illustrates how the blower motor is controlled. With the main switch closed, pulling the button of the fan switch to the first position passes a current through the motor. This current is small because the circuit has a resistor (indicated as "fan resistance" in the diagram); and the blower runs slow under this condition.

Pulling the switch button all the way (to the second position) throws the full battery voltage across the blower motor. A large current flows, and the blower runs with full speed.

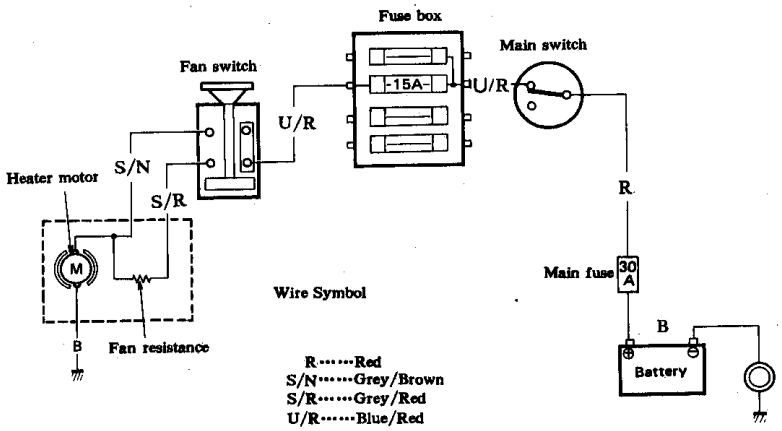


Fig. 7-2

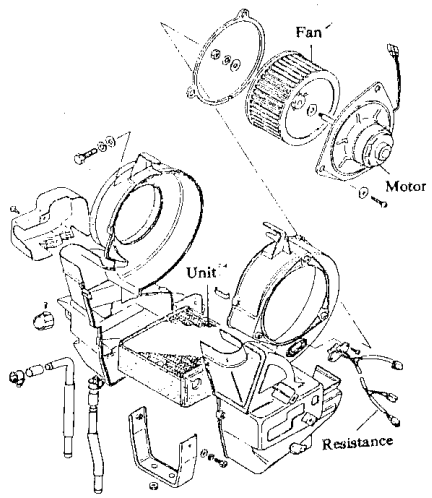


Fig. 7-2-1

7-3. Heater Services

Fan resistor

This resistor is in the heater case. Inspect it for signs of cracking or breakage and replace it as necessary. If the blower motor will not run or when you replace the existing resistor, check to be sure the resistor has an ohmic resistance of 4. 3 ohms. Use a circuit tester for this purpose.

Fan resistor specification	4. 3 ohms

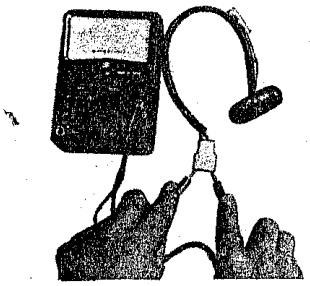


Fig. 7-3

Fan switch

Using a circuit tester, check this switch for circuit continuity:

(1)Switch button in first position

Continuity should be verified betweenS/R and U/R.

(2)Switch button in second position

Continuity should be verified between S/N and U/R.

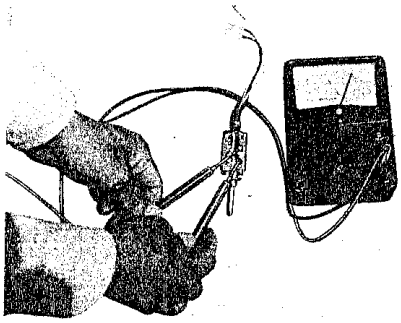


Fig. 7-4

Heater valve

This valve is installed in the heater box. When warm air is wanted in the room, open the valve. During the season not requiring the use of the heater, keep the valve closed.

The rough standard for opening and closing of the heater valve is about 20℃ (68 F)of the outside temperature.

NOTE:
Make sure not to leave the heater hose removed even when the heater is not used. This is important to prevent rust.

Rule of thumb on heater valve		
When outside temperature is:	Above 20℃ (68 F)	Keep the valve tight(closed)
	Below 20℃ (68 F)	Keep the valve loose(opened)

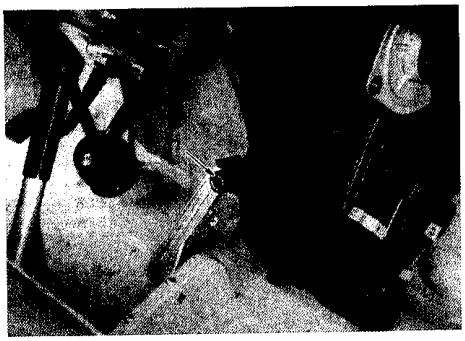


Fig. 7-5

8. IGNITION SYSTEM

8

8-1. Description

The principal components of the ignition system are, as shown in the circuit diagram of Fig. 8-1, the spark plugs, distributor, contact-breaker, ignition coil and, as the source of igniting energy, the battery. Note that the ignition coil has two windings, primary and secondary.

Current from the battery flows through the primary winding and then the contact-breaker; the contact point in the breaker opens and closes to interrupt this current intermittently.

Each time the primary current is interrupted, a very high voltage develops in secondary winding. It is this intermittent high voltage that the distributor passes sequentially to the four spark plugs to fly a spark across the gap in each, one plug a time.

The distributor is sort of rotary switch, whose rotor connects the four plugs, one at a time, to secondary winding of the ignition coil through the wires called "high-tension" cords. Note that there are one high-tension cord, from secondary winding to the center of the distributor cap, and four more high-tension cords between the spark plugs and the four terminals on the cap.

The resistor, connected in series to primary winding, serves to reduce the inductance of primary winding so that the high voltage generation in secondary winding will be stabilized.

NOTE:
Whereabouts of terminal connections are clearly indicated in the diagram below. When inspecting the electrical wiring, refer to this diagram and check to be sure that each connection is tight. Examine the cords for torn insulation and for evidence of grounding.

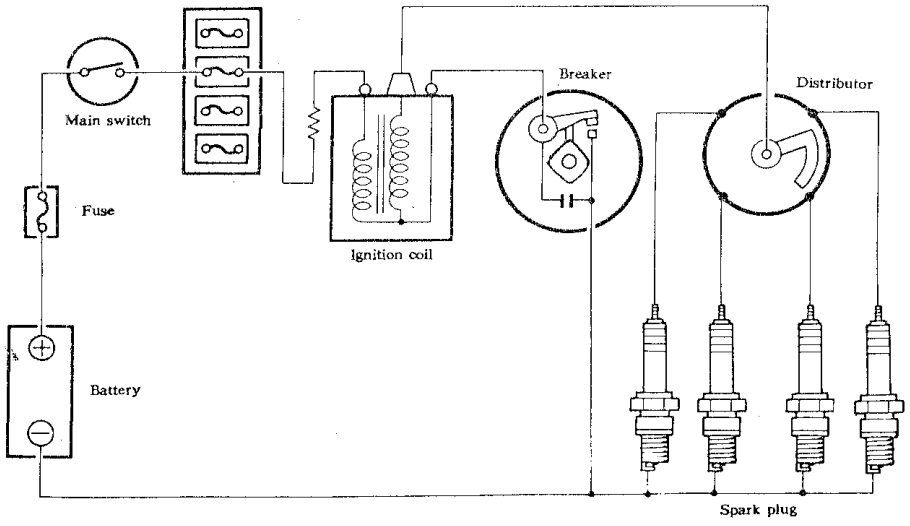


Fig. 8-1

8-2. Description of Components

Distributor

Fig. 8-2 shows the distributor unit in section to expose its internal mechanisms to easy viewing. The shaft is driven from engine crankshaft through worm gearing, and rotates once for every two revolutions of the crankshaft.

Inside the cap are four side electrodes (for spark plugs) and one center electrode (to which the secondary side of the ignition coil is connected). The arm of the rotor, mounted on the shaft, touches the side electrodes one by one "distribute" the high voltage to the spark plugs.

Immediately below the distributing mechanism is the contact-breaker, whose cam, mounted on the shaft, actuates the breaker arm to make and break the primary current circuit for the purpose already mentioned. The condenser (capacitor) secured to the distributor body is for absorbing the current surge, which would otherwise result in a sparking across the contact point gap. The surge occurs every time the contact point is opened, and is due to, so to say, the inertia of electric current. The object served by the condenser is obvious; it is to prevent the point faces from getting burnt by sparking.

The ignition is advanced automatically by centrifugal action and by the difference between inlet manifold vacuum and atmospheric pressure. How the advancer operates will be described in reference to Figs. 8-4, 8-5, 8-6 and 8-7.

Distributor data	
Cam dwell angle	52°
Condenser capacitance	0. 25 microfarad
Ignition timing	10° B. T. D. C. /900r/min (rpm)
Number of gear teeth	13
Direction of rotation	Clockwise, as viewed from top

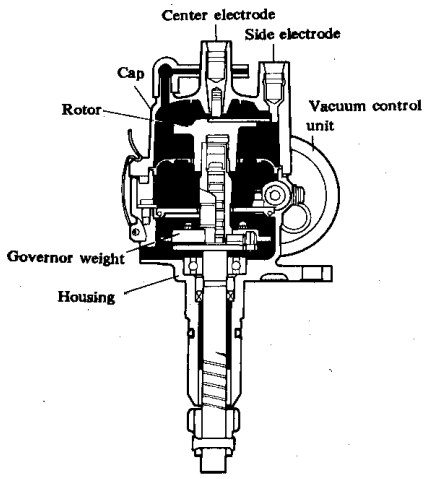


Fig. 8-2

Ignition coil

The ignition coil is a sort of minature transformer and, as such, has an iron core around which two coils are wound — primary and secondary windings mentioned above. The two are so close to each other that a sudden change in the magnetic flux produced by "primary current" flowing in primary winding (in a less number of coil turns) induces a very large electromotive force (voltage) in secondary winding (in a greater number of coil turns). These live parts are housed in a tight, insulator case topped by the cap

mentioned above. Note that the cap has three terminals: one high-tension terminal and two low-tension terminals.

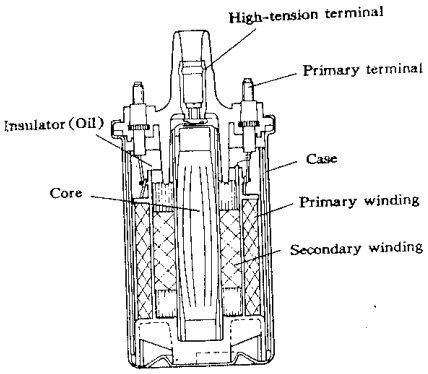


Fig. 8-3

Timing advancer

The distributor shaft, from its driven-gear end to the rotor-carrying end, is not a single solid piece; actually this shaft is in two pieces connected together through the timing advancer. The advancer is essentially a flyweight mechanism. Timing advancing action is accomplished by twisting the top shaft piece relative to the bottom one in the direction of shaft rotation.

The contact-breaker cam, mentioned above, for actuating the breaker arm is mounted on the top piece. The twisting movement is produced by the speed-dependent radial (or spreading) movements of the two flyweights.

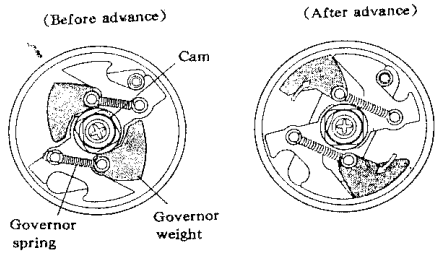
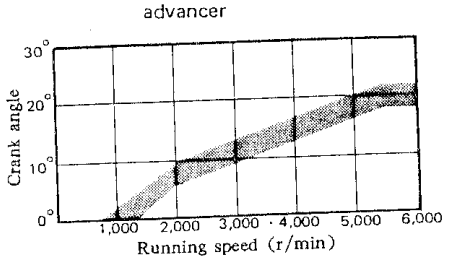


Fig. 8-4

Advancer feature



Vacuum advancer

When the engine is in lightly loaded condition, the amount of fuel being supplied to it is not much and, needless to say, throttle valve is open but a little, so that the vacuum in the inlet manifold side of the carburetor is high.

For fuel economy, it is desirable to advance the ignition when the engine is burning a small amount of fuel. The vacuum advancer utilizes the high vacuum to produce a force for actuating the advancer rod in order to angularly displace the breaker plate.

> **NOTE:**
> **The vacuum advancer starts working to produce the advancing force when throttle valve is 4° to 5° open as measured from its fully closed position.**

The diaphragm is spring-loaded. With a high vacuum, the differential pressure acting on the diaphragm causes to overcome the spring force and move in the direction for pulling the advancer rod. The rod so pulled turns the breaker plate counterclockwise (counter to the direction of distributor shaft rotation) to advance the ignition.

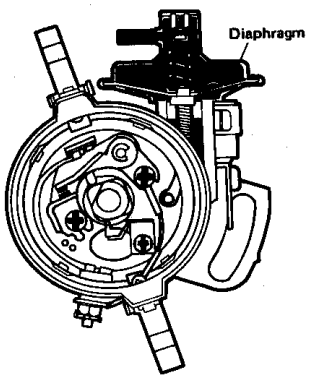
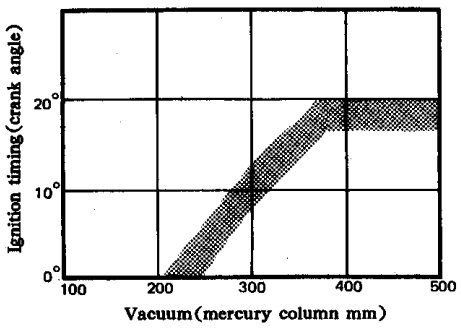


Fig. 8-6



Spark plugs

Each new machine shipped from the factory is fitted with standard plugs.

	Standard type
Nanjing Parking Plug Works	T4196J

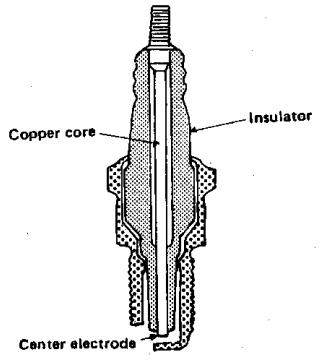


Fig. 8-8

8-3. Maintenance Services

Distributor cap

Leakage of high-tension energy for ignition shows up as misfiring in the engine. It occurs at any part of the high-tension line where insulation has failed or in a dirty distributor cap, that is, an internally dirty cap.

A wider spark gap in the plug, a conditin often found in poorly cared spark plugs, promotes the tendency of high-tension energy to find a short-cut to ground.

Cleanliness is very important for the distributor cap. With a clean dry cloth, wipe off dust or grime, if any, and inspect for any damaged (scarred, scratched or cracked) part or any part evidencing high-tension leakage inside the cap. Be sure to replace such parts.

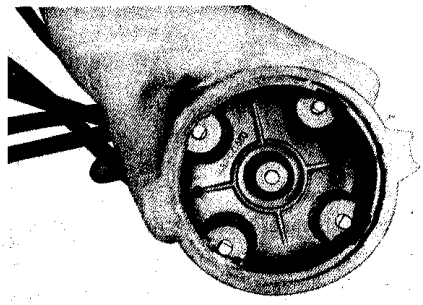


Fig. 8-9

Distributor driven gear

Inspect the gear teeth for wear, and see if the backlash is normal or not. Excessive backlash can be told by turning the shaft back and forth, with its driven gear in mesh with driving gear. Maladjusted ignition timing is often due to excessive tooth wear in this gearing and, in such a case, can be corrected by replacing the driven gear.

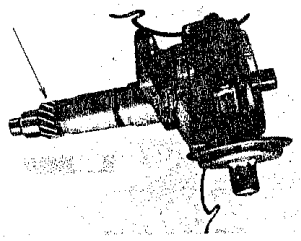


Fig. 8-10

Spark plugs

The spark gap specification is 0. 7 ~ 0. 8mm (0. 027~0. 031in). Be sure to use a thickness gauge in checking the gap. A wide gap is just as bad as a narrow gap. The 0. 7 ~ 0. 8mm (0. 027~0. 031in) gap will produce the right kind of sparks needed by the air-fuel mixture in this engine.

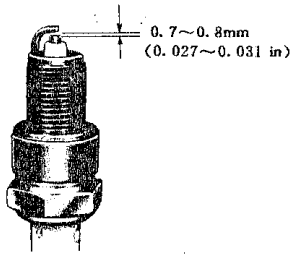


Fig. 8-11

Contact point faces

In the contact breaker, push the breaker arm with your fingertip just a little so that you can see the point faces. If the faces are oily, clean; if roughened, smoothen by grinding. In most cases, the point faces can be reconditioned by grinding with a file or oil stone. Points worn beyond repair must be replaced.

The illustration, below, tells what must be done in each case but the last one showing a pair of properly aligned, smooth faces. Wear or burning is hard to occur in the contact point whose point faces are in the condition labeled "good".

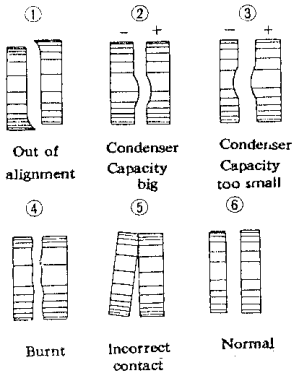


Fig. 8-12

Checking the primary circuit for fault

If the engine misfires or does not fire up at all where its spark plugs have just been checked to be in good condition, the first step of locating the cause is to check the primary circuit (between distributor and ground) for continuity by using a circuit tester as shown. Since the contact point is open, the tester should indicate discontinuity (infinitely large resistance); if continuity is noted, it means that there is a fault somewhere along the primary circuit, which could be in condenser or elsewhere.

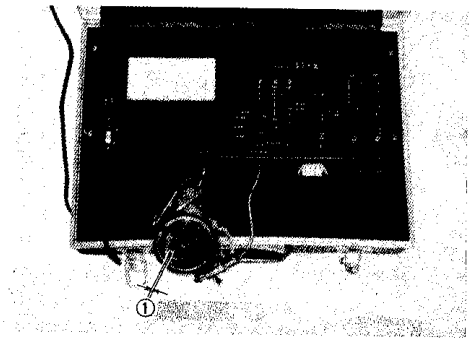


Fig. 8-13 ①*Open*

Condenser

Check the condenser for capacitance by using the electro-tester. You may do so with the condenser in place or removed. When checking it in place, that is ,as mounted on the distributor,be sure to have the contact point opened. A condenser not meeting the following capacitance specification must be replaced:

Condenser capacitance specification	0. 25 microfarad

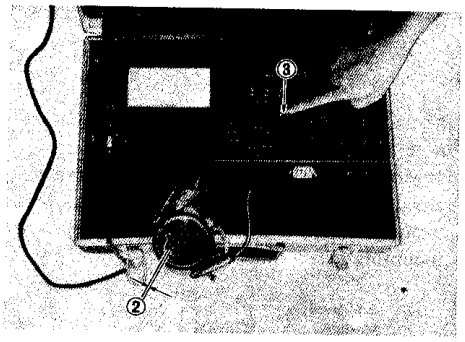


Fig. 8-14 ②*Open* ③*Push*

Ignition coil

(1)Sparking performance test

The purpose of this test is to see if the ignition coil is capable of producing high voltage surges forceful enough to fly good sparks at the ignition coils at all times, particularly when its temperature has risen to the normal operating level. Use of the electro tester is assumed for this test. With the ignition coil connected to the tester, as shown, let the spark fly across the three-needle gap. Continue this testing for about three minutes so that the coil will get warm to simulate the normal operating condition. The coil may be deemed to be in good condition if the sparking is stable, without any misses. In the use of the electro tester for this purpose, do not enlarge the three-needle gap wider than 7mm(0. 27in.)

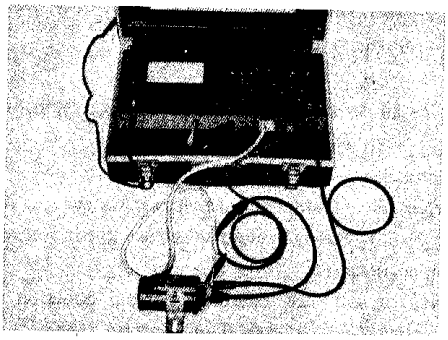


Fig. 8-15

(2)Resistance measurement

Measure the ohmic resistances of primary and secondary windings in the ignition coil. If the readings are in agreement with the prescribed values, indicated below, the coil may be judged to be in good condition. Take readings when the coil is hot, about 80℃(176℉); this is because we are interested in the performance of the coil at the normal operating temperature, not of a cold coil.

Primary winding resistance	About 3ohms (in clusive of the 1. 5ohm resistor)
Secondary winding resistance	About 8kilohms

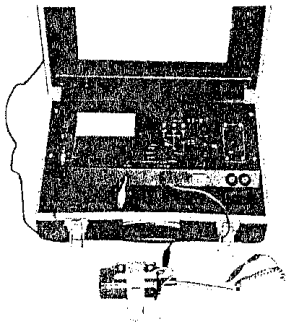


Fig. 8-16

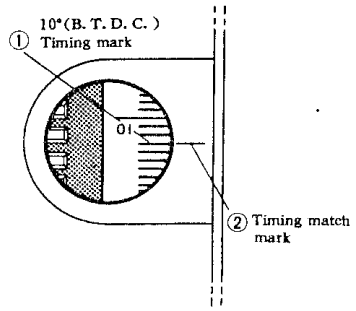


Fig. 8-17

8-4. Important Reminders for Reassembly and Installation

Distributor

When re-installing the distributor, be sure to insert it into the distributor gear case in the following sequence:

1) Turn over crankshaft in normal direction to index the (10° B. T. D. C.)timing mark ① to the timing match mark ②. The 10° mark is the one provided on flywheel. See Fig. 8-17. Normal direction of crankshaft is clockwise as viewed from front side.

> CAUTION:
> After aligning marks ① and ②, remove cylinder head cover to visually confirm that the rocker arms are not riding on the camshaft cams at No. 1 cylinder. If the arms are found to be riding on the cams, turn over crankshaft 360° to align the two marks anew.

2) Remove the distributor cap. Turn the rotor to make the center ③ of rotor flush with mark ④ embossed on the distributor housing, as shown in Fig. 8-18.

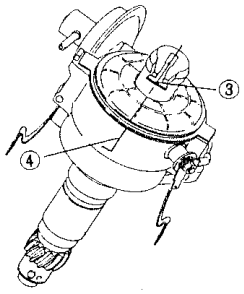


Fig. 8-18

3) Insert the distributor into the distributor gear case, indexing the embossed mark ⑤ of distributor flange to center ⑥ of the distributor mounting screw hole.

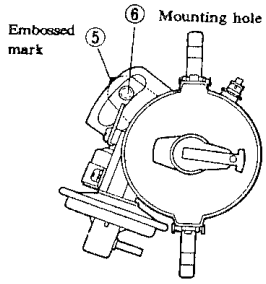
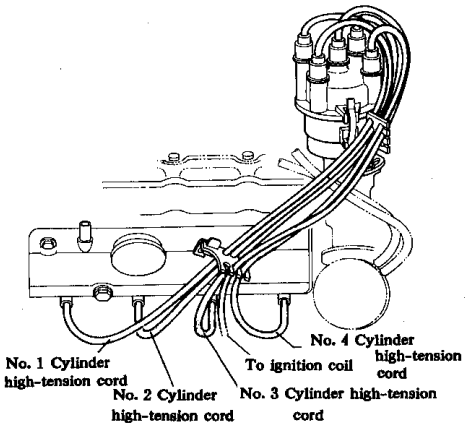


Fig. 8-18-1

High-tension cords

Install the four high-tension cords by referring to Fig. *8-19*, making sure to identify the four cap terminals of the distributor for the four cylinders.



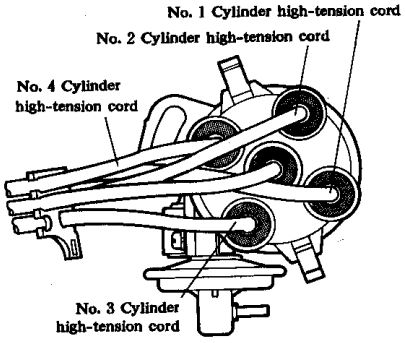


Fig. 8-19

8-5. Ignition Timing

Specifications

Ignition timing	10° B. T. D. C. at 900r/min (rpm)
Ignition order	1→3→4→2
Breaker point gap③	0. 4～0. 5mm (0. 016～0. 019in.)

Checking methods

Check to be sure that the point gap is within the specified range, from 0. 40 to 0. 50mm (0. 016 ～0. 019in.) and then check the ignition timing on No. 1 cylinder. To adjust the point gap, loosen screws ① and move the stationary point with plain screwdriver inserted into slit ②.

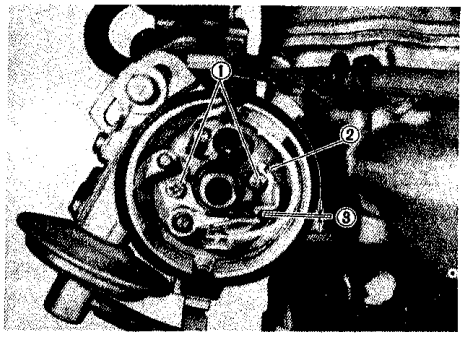


Fig. 8-20

(1)Checking and adjusting with timing light

CHECKING:

Tie the light to No. 1 high-tension cord. Start up the engine and run it at 900r/min. Under this condition, direct the light to the flywheel. If the 10° timing mark ④ appears aligned to the timing match mark ⑤, the ignition is properly timed. See Fig. 8-22.

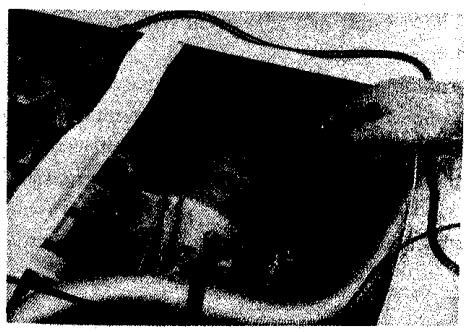


Fig. 8-21

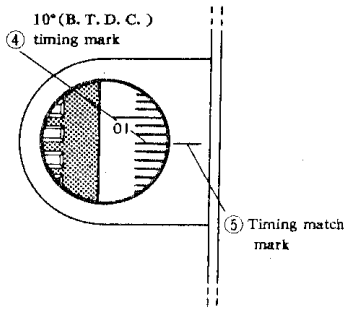


Fig. 8-22

ADJUSTING:

If the mark ④ is off the mark⑤, adjust the timing as follows:

1) Check to be sure that breaker point gap is between 0. 4 and 0. 5mm (0. 016 and 0. 019in.).

2) Loosen the distributor clamp bolt and turn the distributor housing in place to advance or retard the timing.

NOTE:

- Turning the housing counterclockwise advances the timing, and vice versa.
- After repositioning the housing, check the timing with the timing light and, as necessary, repeat step 2).

(2) Checking and adjustment with the timing tester

The timing tester has a built-in buzzer.

Connect one of its leads to the primary-circuit terminal of the distributor and the other lead to the distributor body. Slowly turn the crankshaft by rotating the cooling fan clockwise while watching the timing marks. (have the ignition switch turned off.)

The buzzer should start sounding off just when the marks come into register, indicatiog that the engine is set for the specified timing.

CAUTION:

With timing marks ⑥ ⑦ lined up as shown in Fig. 8-23, remove the cylinder head cover and check to be sure that No. 1 cylinder rocker arms are not riding on cam lobes. If the arms are up, turn over crankshaft by one rotation (360°) clockwise (as viewed from front side). This turning should cause the buzzer to sound off just when the marks come into alignment.

NOTE:

The two tester leads are given polarity signs, (+) to one and (—) to the other lead: connect the red lead to (+) cord, and the black lead to (—) cord, of the distributor.

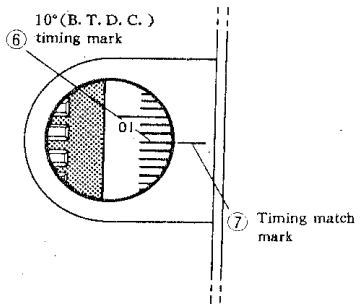


Fig. 8-23

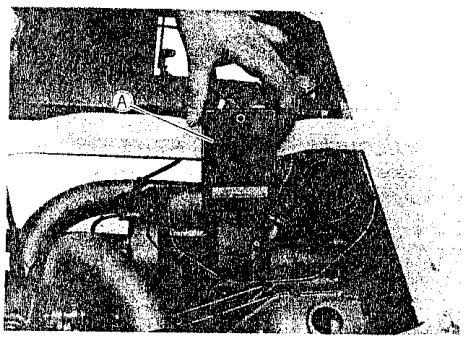


Fig. 8-24 Timing tester

ADJUSTING:

Upon noting that the ignition is not timed to the

specification, proceed as follows:

1) Make sure that the breaker point gap is set right, that is, between 0. 4 and 0. 5mm (0. 016-0. 019in.).

2) Bring timing mark ⑥ into alignment with mark ⑦, as shown in Fig. 8-23. Mark ⑥ represents the 10° crank angle.

3) Loosen the distributor clamp bolt, and slowly rotate the distributor housing until the buzzer starts sounding off. Hold the distributor right there and tighten the clamp bolt.

NOTES:

1. **Turning the housing counterclockwise advances the timing and vice versa.**
2. **After tightening the clamp bolt, check the timing once again.**

Checking the timing advancer action

①CENTRIFUGAL ADVANCE:

Hook up the timing light, disconnect the vacuum hose from the vacuum advancer. Check that the ignition advancer increase up its speed as shown in Fig. 8-4. If not, that means something is wrong with the advancer. The controller return spring cracked or weekened or load bonded results in this problem.

Note:

When ignition timing is in conformity with the readings in Fig 8-4, add 10° to the readings (in static ignition).

②VACUUM ADVANCE:

Connect the vacumm hose again, run the engine without load. Check the flywheel timing mark with the timing light.

a. When the engine runs at 3,500r/m, read out the timing value according to the crank angle.

b. When the engine runs at the speed stated above, remove the vacuum hose from the carburetor, read out another reading. The difference between the first reading and the second one is the advance angle.

Note:

If the first reading is mostly the same as the second one, it means the vacuum advance is wrong.

Note:

Before checking the vacuum advance, be sure no leakage, crack, and damage of the vacuum hose.

8-6. Repalcement of Distributor Drive Gear

Replacing a worn-down driven gear (a part of the distributor assembly) is not enough. Inspect the drive gear, too, and replace it if it is badly worn down. The drive gear can be removed from the camshaft.

Worn gears in the distributor drive are likely to disturb the ignition timing and must be replaced.

When pressing the replacement drive gear onto camshaft, be sure to position the gear angularly as shown in Fig. 8-25. Note that the tooth root is radially centered on the center line through the keyway provided in camshaft.

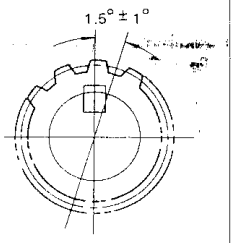
NOTES:

1. **Before removing the drive gear from the camshaft, scribe a match mark on this shaft and, when mounting the replacement drive gear, refer to this mark.**
2. **There is no need to discriminate between the two end faces of the drive gear: the gear may be fitted with either end held foremost.**

CAUTION:

Distributor gear case

Where the distributor gear case has been removed in engine disassembly or at any other occasion, be sure to fill up the case with 60cc (2. 03/2. 11 US/Imp oz) of engine oil after re-installing the case. Never start up the engine with the gear case empty of oil.



Front side view

Fig. 8-25

9. STARTER MOTOR

9-1. Description

A shift-lever type starter motor is used for cranking the engine. The motor is mounted on the crank case, with its drive pinion meshed with the ring gear of the flywheel. In the following illustration, note that the whole motor assembly inclusive of the magnetic switch and lever mechanism is enclosed.

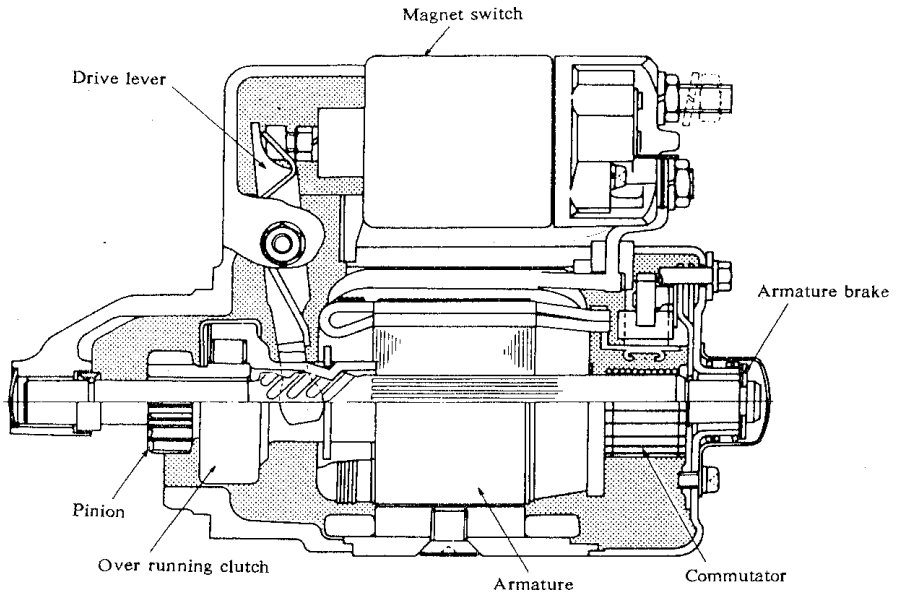


Fig. 9-1

9-2. Specifications

Voltage	12volts
Output	0. 8kw
Rating	30seconds
Direction of rotation	Counterclockwise as viewed from pinion side.
Brush length	19mm(0. 75in.)
Number of pinion teeth	8
No-load characteristic	50A maximum at 11 volts,5,000rpm minimum
Load characteristic	270A maximum at 9. 5 volts and 0. 7 kg-m torque,1,200 rpm minimum
Locked rotor current	600A maximum at 7. 7volts,1. 3kg-m minimum
Magnetic switch operating voltage	8volts maximum

9-3. Cranking Action

Starting up the motor

Turning on the starting switch results in a small current flowing through the holding coil and another through the pull-in coil,both in the magnetic switch. The former current flows direct into ground ,but the latter flows through motor armature and field. In other words,motor begins to run. In the magnetic switch,the two coils energized—pull-in coil and holding coil—develop a combined magnetic pull,by which the moving core is pulled against the force of the spring and moves toward the right(in the illustration). At this time,the motor armature is running but slowly because of the small initial current. As the moving core is forced toward the right,its left end turns the shift lever around its pivot,so that the bottom end of the lever pushes the clutch toward the left . Since the clutch is splined to the motor shaft and because the motor shaft is rotating,the clutch advances toward the left as assisted by the helical splines.

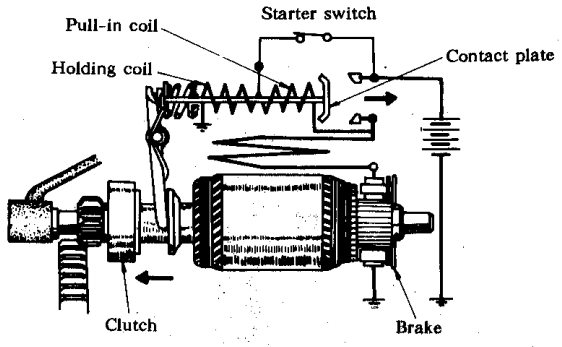


Fig. 9-2

Pinion meshing with the ring gear

The pinion may mesh into the ring gear smoothly or may bounce on the ring gear , depending on the relative positions of their teeth. In the latter event, the springs mounted on the clutch absorb the shock and, since the pinion is rotating and being pushed, its teeth will eventually mesh into those of the ring gear. In either case, the shift lever is allowed to turn fully and permit the moving core to be kept pulled all the way toward the right. When this happens, the main contactor of the magnetic switch closes to connect the starter motor direct to the battery. Consequently, a very large current—load current—flows through the motor to develop a normal cranking torque for driving the engine crankshaft through the drive pinion and ring gear.

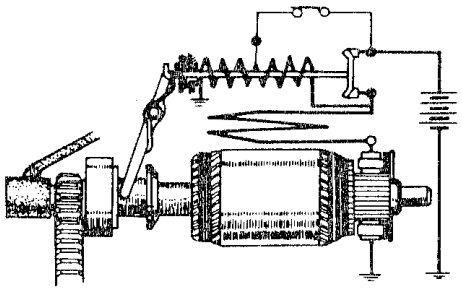


Fig. 9-3

Engine cranking

When the motor is cranking the engine with full force, the pull-in coil is bypassed or shunted but the holding coil remains energized to hold the moving core in its shifted position. Under this condition, the shift lever is pushing the pinion by overcoming the force of springs.

As the engine fires up and begins to run steadily and if the starting switch is kept closed, the ring gear starts driving the pinion. When this occurs, the pinion merely spins on the motor shaft without transmitting this reverse drive to the motor. This is because the clutch is of overrunning type.

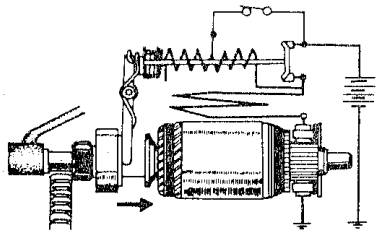


Fig. 9-4

Terminating cranking operation

Turning off the starting switch de-energizes (shutting off the current) the holding coil so that the pull hitherto acting on the moving core disappears. By the force of the spring, then, the shift lever is turned back and the moving core is forced toward the left to open the main contactor. This shuts off the load current, and the drive pinion, shift lever and moving core go back to their original positions.

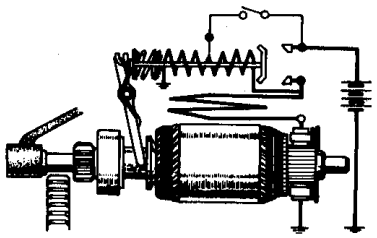


Fig. 9-5

9-4. Removal

1) Disconnect battery cable from the negative(-) terminal of the battery.
2) Disconnect the plus cord(+) and white/brown lead wire from the starter motor.
3) Remove the two bolts securing the starter motor assembly to the crank case, and take off the starter motor.

9-5. Disassembly

1) Remove the nut securing the end of the field coil lead to the terminal on the head of magnetic switch.
2) Take off the magnetic switch①from the starter motor body by removing the two mounting screws.

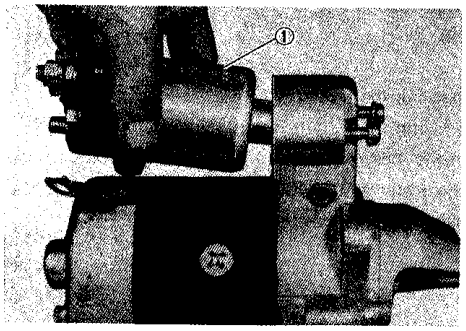


Fig. 9-6

3) Remove the bearing cover②, and take out lock plate brake spring③and rubber④.

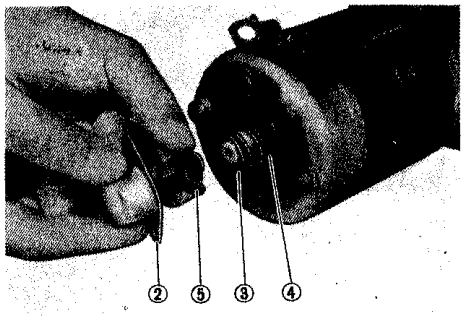


Fig. 9-7 ⑤*Clip*

4) Disassemble the brush holder section in the following sequence:
   (1) Remove two through bolts.
   (2) Detach commutator end frame.
   (3) Draw brushes out of the holder.

(4)Take out the brush holder.

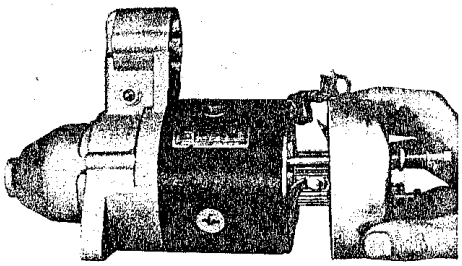


Fig. 9-8

5)Remove the case complete with field coils.
6)Pull off the set pin from shift lever, and take out the rubber and plate inside the housing.
7)From the housing, take out the armature, starter clutch and shift lever.

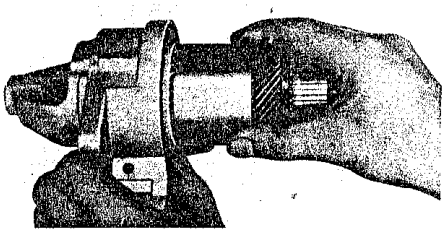


Fig. 9-9

8)Draw off the starter clutch, as follows:
(1)Draw stop nut toward the clutch side.
(2)Remove snap ring and slide off clutch.

9-6. Maintenance Services

In the event the starter motor is found unable to crank the engine, the first thing to be checked is whether the drive pinion plunges out. If the pinion does not plunge out, then the magnetic switch must be checked.

If the pinion plunges out satisfactorily, then the inability of the motor to crank the engine is likely to be due to some defective condition in the commutator or in the armature, provided that the battery is in good condition and that the circuit for applying the battery voltage to the motor is free from any open or fault. Having narrowed the scope of search for the cause of trouble to the motor proper, proceed as follows:

Checking the field coils

Check to be sure that the field circuit is neither grounded or open-circuited. This can be effected by using a circuit tester as shown. If continuity is indicated by the tester hooked to the housing or frame, it means that the insulation has failed, resulting in a grounded field coil. Such a fault can be corrected by repair in most cases.

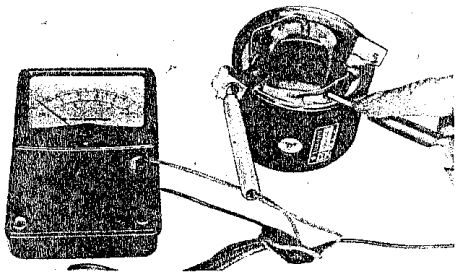


Fig. 9-10

Checking the armature

• Using the circuit tester, see if there is any continuity between commutator and armature core. The tester will indicate infinite resistance if the insulation is in sound condition.

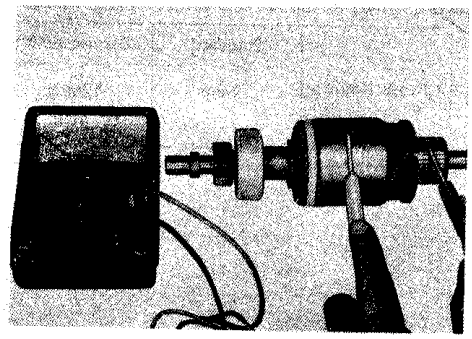


Fig. 9-11

• Again using the tester, check for continuity between each pair of adjacent commutator segments. If discontinuity is noted at any part of the commutator, replace the whole sub-assembly of the armature.

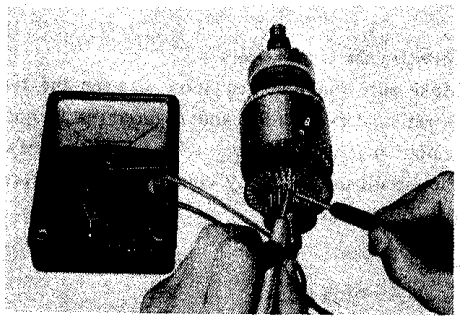


Fig. 9-12

Servicing the commutator

• If the surface of the commutator is gummy or otherwise dirty, wipe it off with a cloth dampened with gasoline. If the surface is coarsened or in burnt condition, smoothen it by grinding with sandpaper. If the surface is grooved deep, it may be necessary to remove the groove marks by turning the commutator in a lathe; such turning is often successful in reconditioning the commutator if the extra stock necessary for removal by cutting is available without reducing its diameter to the limit.

	Standard	Service limit
Commutator diameter	32. 5mm (1. 28in.)	30. 5mm (1. 20in.)

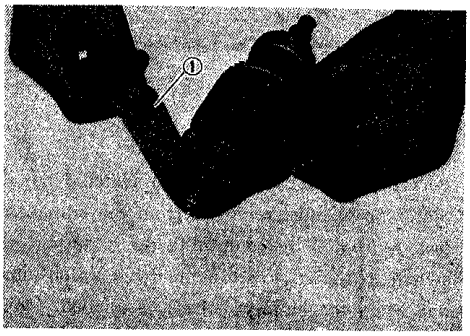


Fig. 9-13 ①Sand paper

• Make sure that the mica between each pair of adjacent segments is undercut to the prescribed depth. The conventional undercutting technique is to be used in repairing the commutator.

	Standard	Service limit
Mica undercut	0. 5～0. 8mm (0. 02～0. 03in.)	0. 2mm (0. 007in.)

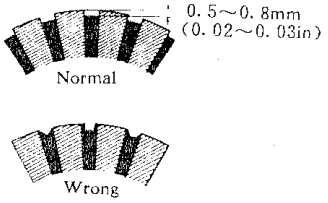


Fig. 9-14

Testing the magnetic switch

Before separating the magnetic switch from the motor proper just removed from the crankcase, test the switch by connecting the battery to the switch, as shown, to see if the drive pinion jumps out when the battery voltage is applied. (With the positive terminal of the battery cable end.) With the switch coils in sound condition, the drive pinion will jump out and, even when the main circuit is opened at "A", will remain in "jumped out" position. If undoing the connection at "A" causes the drive pinion to retract, it means that the holding coil is defective.

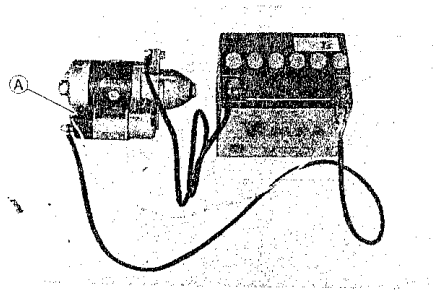


Fig. 9-15

Servicing the brushes

Check the length of each brush. If brushes are worn down to the service limit, replace them.

	Standard	Service limit
Brush length	19mm (0.75in.)	12mm (0.47in.)

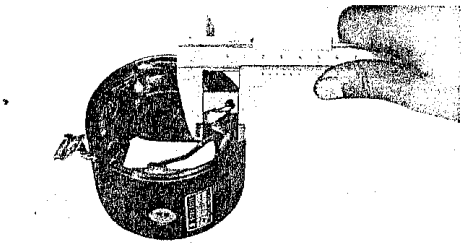


Fig. 9-16

Servicing the brush holders

Make sure that the insulation between the two brush holders, positive and negative, is in good condition. This should be verified with the use of the circuit tester. If any continuity is noted, repair the insulation.

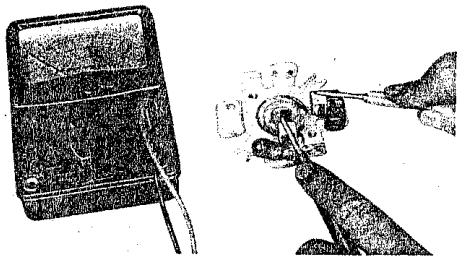


Fig. 9-17

9-7. Important Reminders for Starter Motor Reassembly

Various parts of the starter motor assembly need lubrication at each overhaul. The lubrication points are illustrated below: (Also required is locking by punching.)

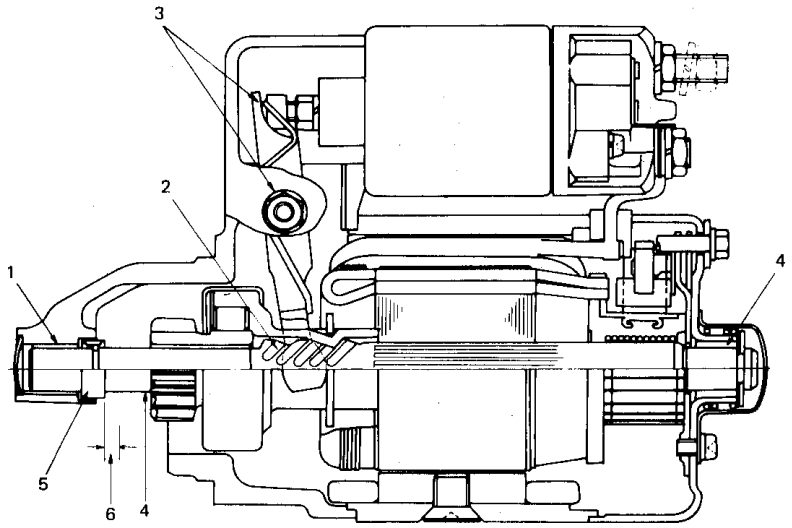


Fig. 9-18

1)Give grease to the bush in the drive housing.

2)Grease the helical splines before mounting the clutch sub-assembly.

3)Grease the sliding or contacting surfaces associated with shift lever.

4)Grease the bush fitted into the end frame and also the armature shaft end inserted into this bush.

5)After installing the stop nut,lock it by staking at two places with a punch.

6)Adjust the length of the moving stud so that the clearance between the stop nut and the pinion in plunged-out condition will be from 1 to 4 mm(0. 04 to 0. 16in.). To check,run the motor in no-load condition to plunge out the pinion and wait till the motor speed settles.

10. CHARGING SYSTEM

10-1. Description

The charging system consists of the alternator complete with a means of rectification for producing DC output power, and the two-element regulator unit for controlling the voltage.

In the alternator, the armature is stationary; it consists of three coils mounted-on the stator in such a way as to produce three-phase alternating voltage. This voltage applies to the rectifier for full-wave rectification. The rectifier delivers power in the form of direct current.

Against the stationary armature, revolving magnetic fields are produced by the field winding carried in the rotor. This feature of construction of the alternator strikes a distinct contrast to the dynamo (DC generator), in which the field is in the stator while the armature is in the rotor.

The magnitude of three-phase AC power available from the alternator to its rectifier is directly proportional to rotor speed and field(excitation)current. It is the function of the regulator unit to control the field current automatically in such a way that the output voltage unit to control the field current automatically in such a way that the output voltage remains constant; another function is to control the circuit of the charge warning lamp. Thus, the regulator unit has two element; one is voltage regulator for performing the first function and the other is voltage relay for the second function.

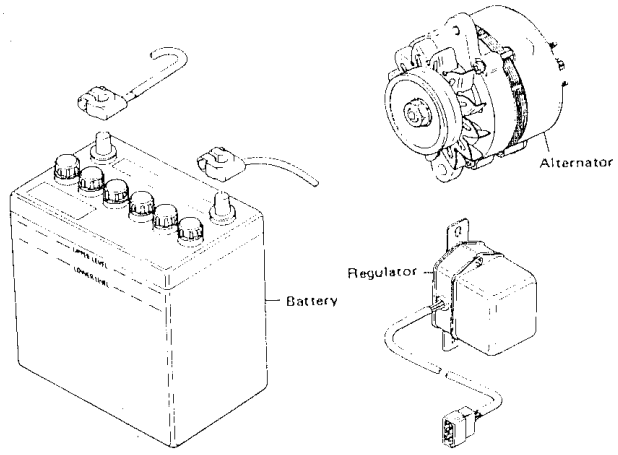


Fig. 10-1

10-2. Charging Operation

The following description of the system operation is referenced to the circuit diagram indicated in Fig. 10-2. Closing the ignition switch connects the charge warning lamp to the battery; a small current flows through the lamp, lighting this lamp to signify that the alternator is not charging the battery, and through the contact point of voltage relay to ground. Another current flows from the battery through the contact point of voltage regulator into the field winding in the alternator rotor, thereby producing magnetic fields around the rotor. These fields, which are stationary at this time because the rotor is not

running, link the armature coils and the rotor poles through the air gap between stator and rotor.

Under these conditions, suppose the engine is started up. The rotor begins to run, and its magnetic fields revolve to "cut" the three armature coils in succession. In each armature coil, an electromotive force is generated by electromagnetic induction. This force changes its direction alternately. Consequently, the three armature coils apply three alternating voltages to the rectifier. Viewed collectively, these voltages constitute the three-phase output voltage of the alternator.

The rectifier consists of three pairs of rectifying diodes, forming three one-way paths of current for full-wave rectification to convert the alternator output power into a direct current power, which is available from the "B" terminal of the alternator-rectifier unit, relative to "E" (ground) terminal.

As the engine picks up speed, the electromotive force induced in each armature coil increases, so that the output voltage appearing at terminal "B" (relative to terminal "E") becomes high enough to "push" electricity into the battery through its positive terminal. In other words, the battery begins to draw a charging current.

Let' s take a look at the pressure coil of the voltage relay. One end of this coil is connected to terminal "E" and the other end to the neutral point "N" of the three armature coils. Potential level of "E" (ground) is now so much lower than that of "N" that a current flows in the pressure coil to develop a magnetic pull. Consequently, point "P5" separates from point "P4" and touches point "P6"; the charge warning lamp thus becomes shunted and stops burning to signify that the battery is getting charged.

During the early stage of engine starting, the alternator output voltage may be lower than the battery voltage; even in such a case , no current flows from the battery into the alternator because of the rectifier diodes. The reason why a cutout relay is not used here is explained by the presence of the diode rectifier.

The function of the voltage regulator with its voltage coil is to alter the path of field (excitation) current for the field coil, in order to maintain the alternator output voltage at a relatively constant level. When this voltage rises owing to a rise in engine speed, the voltage coil pulls point "P2" away from point "P1", thereby introducing the control resistor "R1" into the field circuit. Field current falls slightly because of this resistance and , consequently, the output voltage falls to the normal level. If the engine picks up speed further, the magnetic pull developed by the voltage coil increases to bring point "P2" into contact with "P3", thereby shunting the field coil to reduce the field current to zero. Under this condition, voltage generation in the alternator is dependent on the residual magnetization of the rotor, which is small enough to keep down the output voltage to the normal level.

The foregoing description of the voltage regulator operation may be summarized as follows; the regulator controls the alternator output voltage by controlling the field current in three steps; first allowing a full field current to flow; secondly, by inserting a resistor into the circuit to reduce the field current; and thirdly, by shunting the field coil to reduce the current to zero.

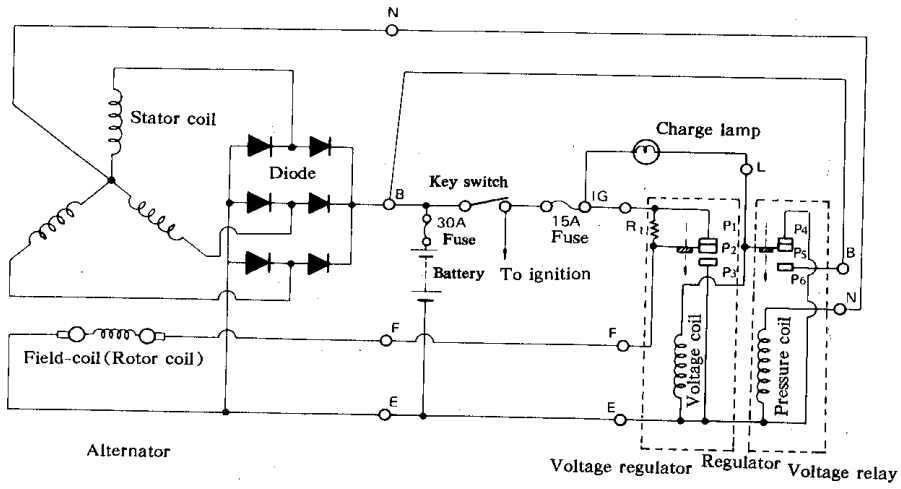


Fig. 10-2

10-3. Alternator

Description

In order to distinguish it from conventional automotive dynamos, the AC generating device is called an alternator for it produces a DC output from three alternating currents generated in its winding.

The alternator consists of: the rotor (which produces revolving magnetic fields), stator (which is a series of coils disposed and arranged to form three coil groups), two slip rings and two brushes (through which DC excitation current is fed into the field winding of the rotor), and the rectifier (which consists of 6 semiconductor diodes, and is built in the alternator).

In operation, the revolving magnetic fields "cut" the stator coils. In other words, the three groups of coils experience changes in magnetic flux. By the flux changes, an alternating electromotive force (emf) is induced in each coil group. Thus, three alternating voltages are available from the stator.

The six diodes are arranged so that they "rectify" or convert the three alternating outputs into a DC output. Three-phase full-wave rectification is effected by the built-in rectifier.

In terms of electric current, a diode is a circuit element that passes the current only in one direction. Of the six diodes, three are arranged to pass currents in the same direction, and the remaining three in the opposite direction. Since three alternating currents undergo full-wave rectification and are combined into one by superposition and are combined into one by superposition, the DC output of this alternator is much steadier and carries much less pulsating or ripple components than a DC output made available by full-wave rectification of a single-phase alternating current.

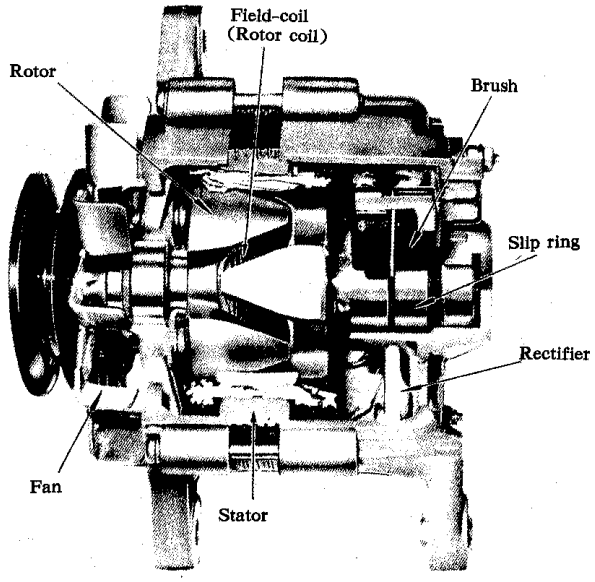


Fig. 10-3

Data and Specification

Nominal operating voltage	12Volts
Maximum alternator output	35A
Polarity	Negative ground
Effective pulley diameter	65mm(2.56in.)
No-load alternator speed	1,050~1,250rpm, 14 Volts at normal temperature
Full-load alternator speed	4, 000rpm maximum, 35A,14 Volts at normal temperature
Direction of rotation	Clockwise as viewed from pulley side
Maximum permissible alternator speed	13,000rpm
Working temperature range	-40°C~80°C (-104°F~176°F)
Rectification	Full-wave rectification

Removal

(1) Disconnect the negative battery cable from the battery.

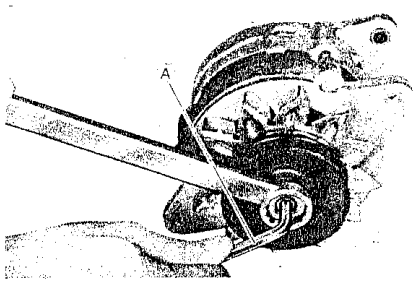
(2) Disconnect from the alternator the red cord and circuit coupler.

(3) Remove the bolts securing "V" belt adjusting arm and alternator and take down the alternator.

Alternator Disassembly

Remove the nut securing the fan to the rotor shaft. To do so, the shaft must be held rigid and steady by using a special tool Ⓐ.

Hexagon wrench, 6mm



Fig, 10-4

Remove the 3 bolts fastening the end frame to the rotor housing; tap on the edges of the end frame with a wooden mallet to separate it from the housing, thereby severing the rotor from the stator.

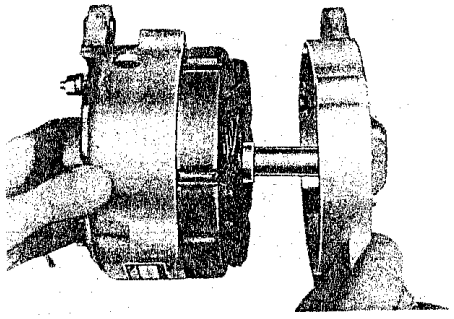


Fig. 10-5

Draw out the rotor. It may be necessary to lightly tap on the core and housing.

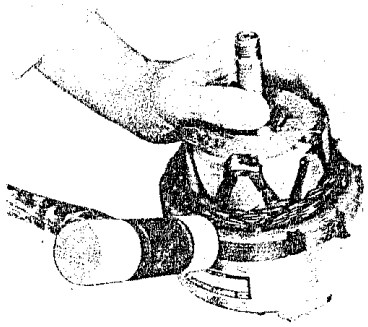


Fig. 10-6

Remove the 3 nuts securing the rectifier holder in place, and one other nut holding down the terminal insulator. Remove the rear end cover.

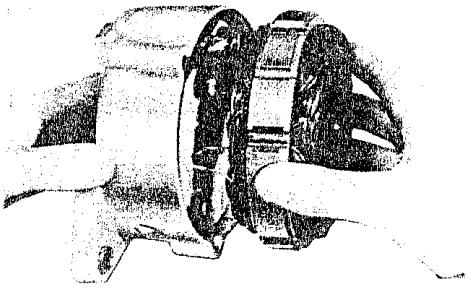


Fig. 10-7

Remove the brush holder from the stator.

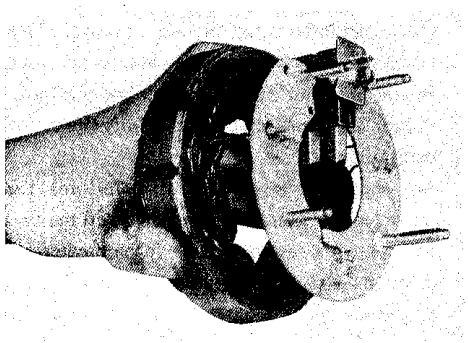


Fig. 10-8

NOTE;
The alternator is to be reassembled by reversing the foregoing sequence of steps. Before inserting the rotor into the housing, be sure to have the brushes installed in the holder. (Use a propersize rod(Ⓐ, manipulating it from the rectifier side, to set the brush in the holder.)

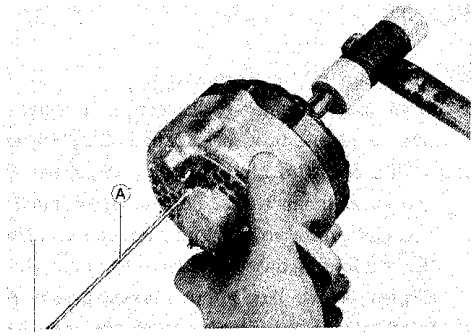


Fig. 10-9

Maintenance Services

(1)Rotor

• Testing the rotor for open-circuit

Check to be sure there is continuity between the two slip rings when tested as shown. Absence of continuity means that the field coil is open-circuited and must be replaced.

Ring-to-ring circuit resistance	4～5ohms

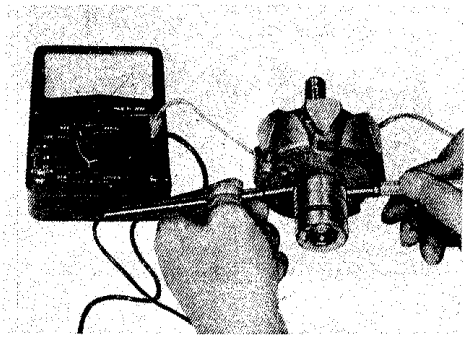


Fig. 10-10

• Testing the rotor for grounding

Check to be sure there is no continuity between the slip ring and the rotor shaft when tested as shown. Presence of any continuity means that the insulation on the field coil has failed, making it necessary for the rotor to be replaced.

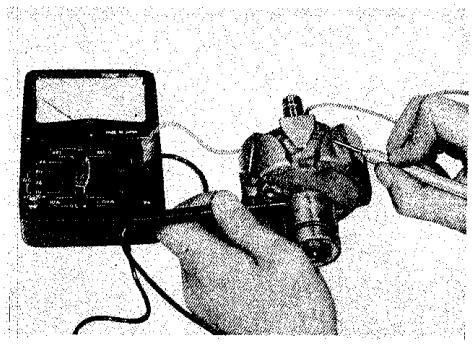


Fig. 10-11

(2)Stator

Check to be sure there is no continuity between the stator core and each armature coil; any continuity noted means that the coil is grounded. A grounded armature coil can be

corrected by locating the faulted point and repairing the fault.

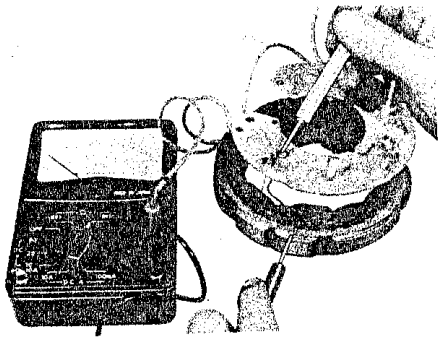


Fig. 10-12

(3)Brushes

Check each brush for wear by measuring it length, as shown. If the brush is found worn down to the service limit, replace the brush and holder altogether.

	Standard	Service limt
Brush length	16.5mm (0.65in.)	11.0mm (0.45in.)

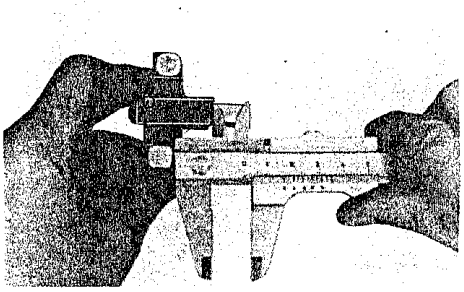


Fig. 10-13

(4)Rectifier

The rectifier is to be checked with the ohmmeter for continuity in one direction and non-continuity in the other direction.

Put ohmmeter lead to terminal "B" and the other lead to terminal "N"; then swap the two leads. Of the 2 ohmmeter indications, one should be about 20 ohms, meaning continuity, and the other should be infinity (non-continuity).

Put ohmmeter lead to terminal "N" and the other lead to terminal "E"; then swap the two leads. In this case, too, the two ohmmeter indications should be similar to those mentioned above.

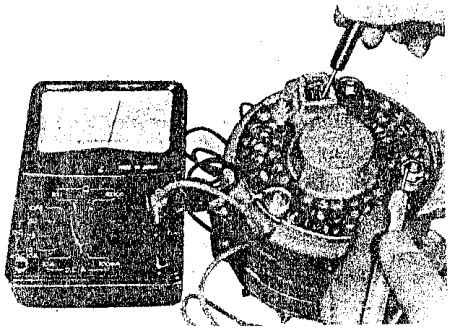


Fig. 10-14

(5)Alternator load performance

With the alternator-rectifier unit in place, run the engine in a speed range of 3,000 to 4,000rpm, with head lamps, 4-way flashers and wiper motor turned on, and check the alternator output voltage and current. Compare the readings against the prescribed values, indicated below. An output current which is small means the possibility of the rectifier being defective, any of the stator (armature, coil open-circuited, or an insulation failure resulting in a grounding fault).

Standard output voltage and current	13.8~14.8volts, 20A minimum

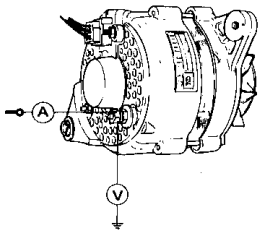


Fig. 10-15

10-4. Alternator Regulator

In the two-element regulator, one coil acts as voltage limiter or regulator and the other coil as relay for controlling the charge warning lamp. It should be noted in the circuit diagram that the magnetic pull developed by the voltage coil to move its moving point "P2" is roughly proportional to the alternator output voltage, whereas the magnetic pull developed by the pressure coil of the relay is dependent on the potential level of neutral point "N" of the armature with respect to the ground. A clear understanding of these relations is essential in checking, testing and servicing the regulator unit.

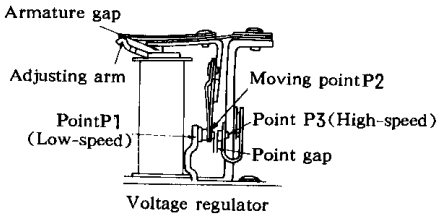


Fig. 10-16

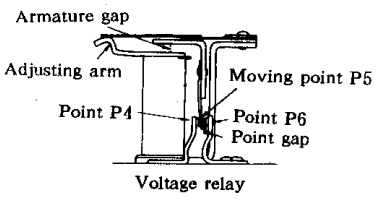


Fig. 10-17

Specifications

Regulated voltage	13.8～14.8volts
Voltage-relay cut in voltage	4～5.8volts

Maintenance services

(1) Voltage-regulator limiting action test

Hook up a voltmeter, inserting it between the alternator "B" terminal and ground, and run the engine within a range 2,000 to 3,000r/min, while reading the voltmeter indication. The voltage read is the charging voltage as limited by the action of the voltage regulator; the reading should be within the prescribed range, which is indicated below. If the charging voltage is found too high or too low, adjust it by bending the adjusting arm of the voltage regulator.

Prescribed range of charging voltage	13.8～14.8volts for 2,000～3,000 revolution(rpm)

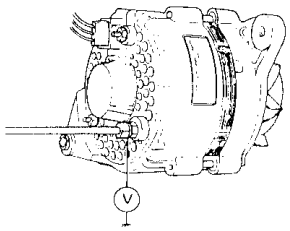


Fig. 10-18

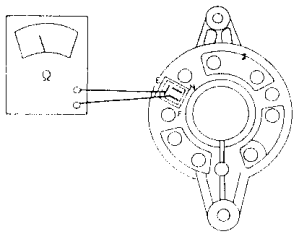


Fig. 10-19

(a) If the charging voltage is noted to oscillate or otherwise be unstable, it is most likely that the contact point faces in the voltage regulator are dirty or roughened. Cleaning and smoothening the faces will remedy this malcondition.

(b) If the charging voltage is too high, the possible causes are as follows:

- Armature gap is too wide on low-speed side or high-speed side in the voltage regulator.
- Contact resistance at high-speed side point is too large.
- The coil of voltage regulator or relay is open-circuited.
- Open circuit in the line to "N" or "B" terminal of the regulator unit. (Refer to Fig. 10-20)
- Contact pressure is too high on low-speed side point.
- Imperfect grounding of the regulator unit.

(2) Continuity test on field coil

Using the ohmmeter, check for continuity between the "E" and "F" terminals of the alternator, as shown. The meter should indicate continuity with a resistance value meeting the following specification:

Standard field circuit resistance	6~9 ohms

(a) If the resistance value noted is too small, it is likely that there is a short-circuit through insulation layers in the coil.

(b) If the resistance value noted is too large, the following possibilities must be considered:

- An open-circuit is developing in the field coil.
- The brushes are not seated properly on the slip rings.
- Brushes or slip rings are burnt.

(3) Checking terminal-to-terminal resistances

Pull off the connector from the regulator unit, remove the cover, and check the resistance between terminals. Refer the resistance readings to the following chart to diagnose the internal condition of the regulator unit:

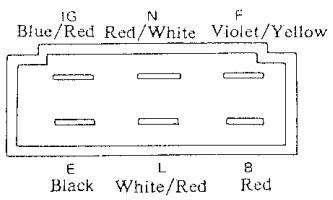


Fig. 10-20

Guide on regulator diagnosis				
Terminal checked	State of vol. relay	State of vol. regulator	Normal resistance value (ohms)	Diagnosis
IG-F		Standstill	Zero	If not zero, point contact is detective on low-speed side.
		Operated	Approx. 11	If infinity is noted, control resistor is open-circuited.
L-E	Standstill		Zero	If not zero, relay contact point is not closing fully.
	Operated		Approx. 100	If zero, relay point faces are fused together. If infinity is noted, voltage coil is open-circuited.
N-E			Approx. 24	If zero, pressure coil is shorted. If infinity, pressure coil is open-circuited.
B-E	Standstill		Infinity	If not infinity, relay point faces are fused together.
	Operated		Approx. 100	If zero, voltage coil is shorted. If infinity, voltage coil is open-circuited or contact action of the point is defective.
B-L	Standstill		Infinity	If not infinity, relay point faces are fused together.
	Operated		Zero	If not zero, contact action of the point is defective.

NOTE:
In the above chart, "standstill" means that the regulator unit is in de-energized state; "operated" means that the armature is pulled in by the coil.

(4) Gap adjustment

(a) Voltage relay

Using a thickness gauge, check the two gaps, point gap and armature gap. Refer the gauge readings to the specification value, left, and adjust the gaps as necessary.

Gap specifications	
Armature gap	Approx. 0.6mm (0.023in.)
Point gap	Approx. 0.4mm (0.015in.)

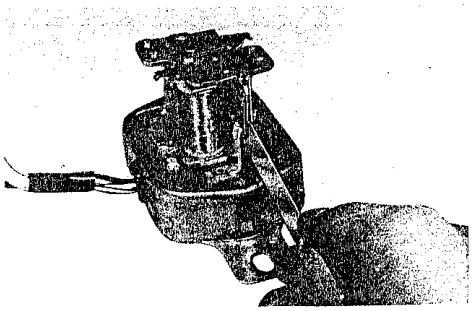


Fig. 10-21

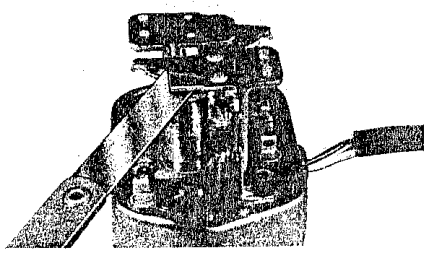


Fig. 10-22

(b)Voltage regulator

Two gaps are to be checked: point gap, and armature gap. Use a thickness gauge, and compare the readings taken against the following specifications. Adjust the gaps as necessary.

Gap specifications	
Armature gap	Approx. 1.1mm(0.043in.)
Point gap	Approx. 0.5mm(0.019in.)

10-5. Battery

1)Battery specifications

Model	6-QA-36
Rated capacity	36AH, 12Volts
Electrolyte	2.2litres (5.3/4.4 US/Imp. Pt.)
Electrolyte S. G.	1.280 when fully charged at 25°C(68°F)

2)Care of the battery

The following information is basic in nature and is nothing new; it is merely a reiteration of what every service shop personnel knows about the automotive storage battery. The information is intended to serve as a reminder to the reader, with a hope that he will, in turn, remind each final user of the important basic facts about the battery whenever opportunity permits him to engage in a conversation with the final user in the shop or out of the shop.

(1)The battery is a vary reliable component, but needs periodical attentions.

Keep the battery container clean; prevent rust formation on the terminal posts; keep the electrolyte surface up to level in each cell-uniformly in all cells; and try to keep the battery fully charged at all times.

(2)Preserve the capacity of the battery.

There is a limit to the ability of the battery to hold electricity in store. This limit is called"capacity."

There are several ways for the battery to lower its capacity:

(a)Loss of electrolyte, or fall in electrolyte level.

When this happens, the battery cannot hold so much electricity as it originally could. Handle the battery with care when you take it down. Barring the loss of electrolyte by careless spilling or other-

wise, the electrolyte level goes down gradually in the battery at work because the water content of it evaporates. Periodically refill distilled water to each cell, as necessary, so that the electrolyte is always up to the specified level. Never allow its surface to fall so much as to expose the cell plates.

(b) Overcharging the battery in place or off the machine.

In recharging the battery off the machine, caution must be exercised so as not to overcharge it. Overcharging gives rise to several complexities. For one thing, it heats up the battery to melt the pitch to result in a destroyed battery. Overcharging could occur in a battery in place if the voltage regulator is maladjusted to allow the alternator (or the dynamo in other machines) to develop too high an output voltage. For another thing, "gassing" occurs in a battery being overcharged to result in a loss of water content. One of the most serious consequences of overcharging is the swelling of positve-plate grids, causing the grids to crumble and the plates to buckle.

(c) Undercharging the battery in place.

Regulator malfunctioning is usually the cause of the battery remaining in a state of charge far below its capacity. This condition is very undesirable in freezing weather, for the electrolyte in such a battery can easily freeze up to result in a destroyed battery. Moreover, an undercharged battery is an easy prey to a greater evil-sulfation.

(d) Sulfation.

Let us recall the electrochemical reactions that take place in the battery during charging and discharging. As the battery gives out its energy (discharging), the active materials in its cell plates are converted into lead sulfate. During recharging, this lead sulfate is reconverted into active material. If the battery is allowed to stand for a long period in discharged condition, the lead sulfate becomes converted into a hard, crystalline substance, which will not easily turn back to the active material again during the subsequent recharging. "Sulfation" means the result as well as the process of that reaction. Such a battery can be revived by very slow charging and may be restored to usable condition but it is a damaged battery and its capacity is lower than before.

(3) Keep the battery cable connections clean.

The cable connections, particularly at the positive (+) terminal post, tend to become corroded. The product of corrosion, or rust, on the mating faces of conductors resists the flow of current. The inability of the starter motor to crank the engine is often due to the rust formation in the battery cable connection. Clean the terminals and fittings periodically to ensure good metal-to-metal contact, and grease the connections after each cleaning to protect them against rusting.

(4) Be always in the know as to the state of charge of the battery.

The simplest way to tell the state of charge is to carry out a hydrometer test. The hydrometer is an inexpensive instrument for measuring the specific gravity (S. G.) of the battery electrolyte. Why measure the S. G. ? Because the S. G. of the electrolyte is indicative of the state of charge.

The direct method of checking the battery for state of charge is to carry out a high-discharge test, which involves a special low-reading voltmeter, an expensive instrument used generally in the service shops but no recommendable to the user of the machine.

At 20°C of battery temperature (electrolyte temperature) :

The battery is in FULLY CHARGED STATE if the electrolyte S. G. is 1. 280.

The battery is in HALF CHARGED STATE if the S. G. is 1. 220.

The battdery is in NEARLY DISCHARGED STATE if the S. G. is 1. 150and is in danger of

freezing.

What if the battery temperatures not 20°C(68°F)? Since the S. G. varies with temperature, you have to correct your S. G. reading(taken with your hydrometer)to the value at 20°C, and apply the corrected S. G. value to the three-point guide stated above. This manner of correction needs a chart showing the relation between S. G. and temperature. There is a simpler way: refer to the graph given below, which tells you the state of charge for a range of S. G. value and a range of temperature.

How to use the temperature-corrected state-of-charge graph.

Suppose your S. G. reading is 1. 28 and the battery temperature is -5°C(23°F). Locate the intersection of the -5°C line and the 1. 28 S. G. line. The intersection is "A". It is in the zone for CHARGED STATE. How much is the battery charged? To find out the answer, draw a line parallel to the zone demarcation line, extending it to the right, and see where this line crosses the percentage scale. In the present example, the line crosses at, say, 85% point. The battery is 85% fully charged.

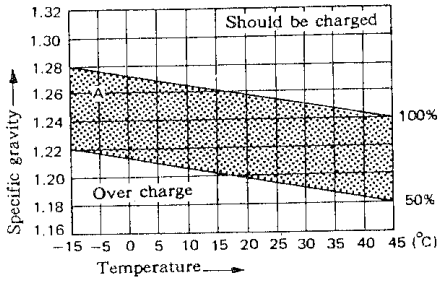


Fig. 10-24

11. CLUTCH

11-1. Description

The clutch is a diaphragm-spring clutch of dry single disc type, as shown in the cross sectional view of Fig. 11-1. The diaphragm spring is of tapering-finger type, which is a solid ring in the outer diameter part, with a series of tapering fingers pointing inward. The disc, carrying four torsional damper rubber, is slidably mounted on the transmission input shaft with a serration fit.

The clutch cover is secured to the flywheel, and carries the diaphragm spring in such a way that the peripheral edge part of the spring pushes on the pressure plate against the flywheel (with the disc in between). When the clutch release bearing (throwout bearing) is held back; This is the engaged condition of the clutch.

Depressing the clutch pedal causes the release bearing to advance and push on the tips of the tapering fingers of diaphragm spring. When this happens, the diaphragm spring acts like the release levers of a conventional clutch, pulling the pressure plate away from the flywheel, thereby interrupting the flow of drive from flywheel through clutch disc to transmission input shaft.

The clutch construction is simple, well balanced relative to rotating speed, durable and capable of withstanding high torsional load and, what is particularly noteworthy, does not require the adjustment of the kind involved in the conventional coil-pressure-spring release-lever type of clutch.

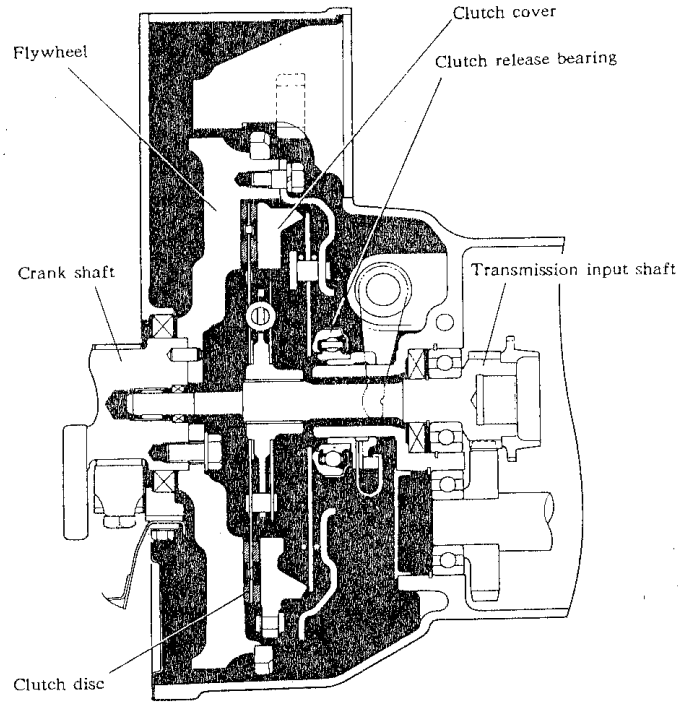


Fig. 11-1

11-2. Removal

Removal of the clutch presupposes that the transmission has been dismounted according to the method outlined in the section for the transmission.

Remove the 6 bolts securing the clutch cover to the flywheel, and take off the cover and clutch disc.

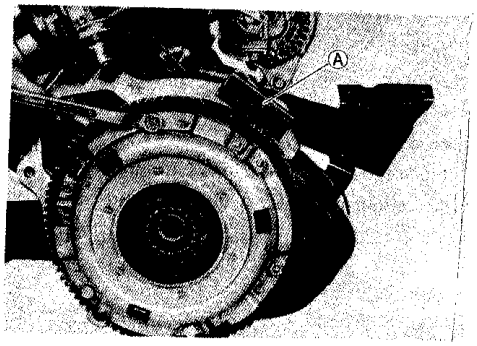


Fig. 11-2 *Ⓐ Flywheel stopper*

With the clutch release bearing attached to the retainer, remove the retainer spring from the release shaft. The release bearing will come off as the spring is being removed.

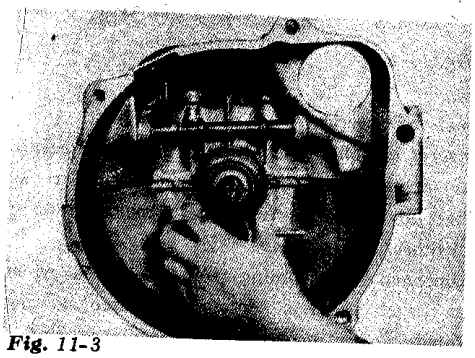


Fig. 11-3

11-3. Maintenance Services

Clutch disc facing surface condition

A burnt or glazed (glass-like surface) facing can be reconditioned by grinding it with No. 120～200 sandpaper. If the surface is in bad condition beyond repair, replace the whole clutch disc assembly.

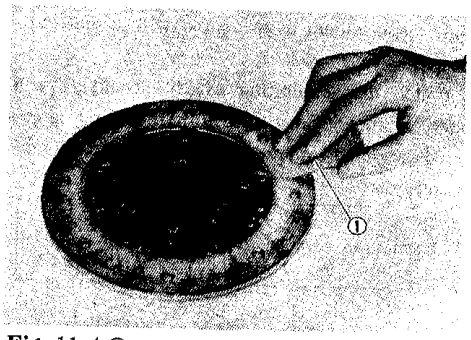


Fig. 11-4 ①Sandpaper

Clutch facing wear

Check the wear of the facing by measuring the depth of each rivet head depression, which is the distance between rivet head and facing surface. If the depressing is found to have reached the service limit at any of the holes, replace the clutch disc assembly.

	Standard	Service limit
Rivet head depression	1.2mm (0.05in.)	0.5mm (0.02in.)

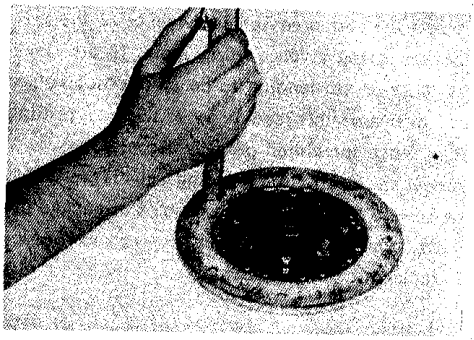


Fig. 11-5

Backlash in disc serration fit

Check the backlash by turning the disc back and forth as mounted on the transmission input shaft. Replace the disc assembly if the backlash is noted to exceed the limit. Backlash here is a circular displacement as measured with a dial indicator.

A clutch disc exhibiting a large backlash will make an impact noise each time the clutch is engaged, and will prevent the clutch to engage smoothly.

	Service limit
Backlash in serration fit	0.5mm(0.02in.)

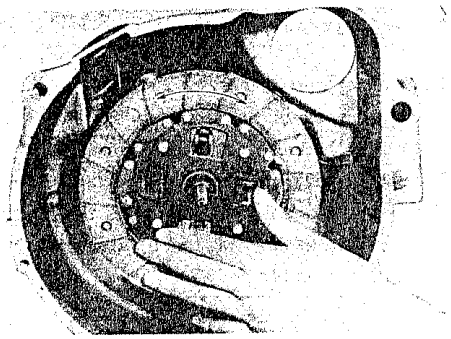


Fig. 11-6

Clutch cover

Inspect the clutch cover for evidence of the diaphragm spring rivets getting loose. If the rivets are loose or are tending to become loose, replace the cover assembly; such a cover makes a rattling noise when the clutch pedal is depressed.

Inspect the tips of the tapering fingers (to which the release bearing exerts a push to disengage the clutch) for wear. If the tips are worn excessively. replace the cover assembly.

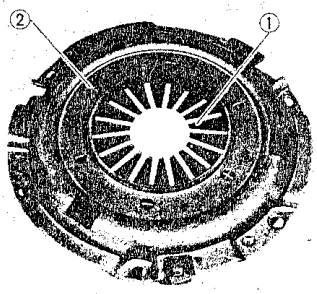


Fig. 11-7 ①Spring wear, ②Rivet

Release bearing

Replace the release bearing if it sticks, rattles or makes abnormal noise when spun and turned by hand.

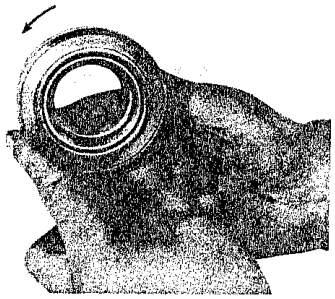


Fig. 11-8

Input shaft bearing and oil seal

Inspect the pilot bearing (by which the forward end of the input shaft is piloted in the crankshaft) and oil seal for evidence of malcondition at all times.

Abnormal noise coming from the clutch, when the clutch pedal is depressed to disengage the clutch, is often due to a defective pilot bearing.

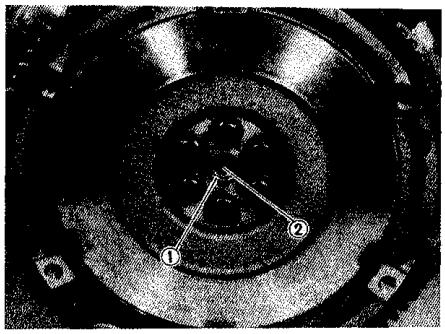


Fig. 11-9 ①Oil seal ②Bearing

Clutch cable lubrication

Apply grease to the hook part③and joint part④ of clutch cable.

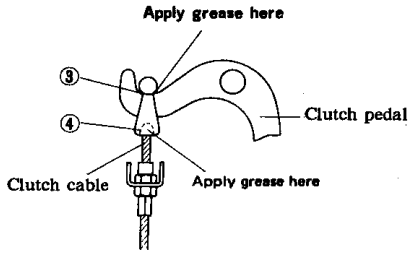


Fig. 11-10

Clutch pedal play

There are two places where adjustment is to be made for giving a proper amount of play to the clutch pedal. One is the clutch cable adjuster⑤, above the engine mounting member; and the other is the inner cable adjusting nut at the distal end of the clutch release lever. The play is prescribed to be within the following range:

Clutch pedal play	20～30mm (0.9～1.2in.)
Clutch release arm play	3～4mm (0.12～0.16in.)

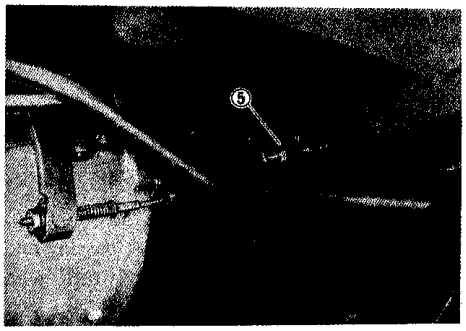


Fig. 11-11

11-4. Installation

The clutch is to be installed by reversing the removal procedure. Some important steps will be explained in detail.

Clutch disc and clutch cover

A special tool must be used to install the disc and cover, in order to align the two to the transmission input shaft. The tool is a sort of dummy; insert it into the bearing (pilot bearing) (as if it were the transmission input shaft). Then mount the disc and cover and, after bolting up the cover to the flywheel, draw off the mounting tool Ⓐ.

Ⓐ: Clutch disc center guide

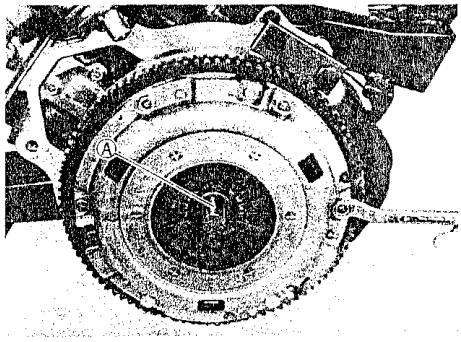


Fig. 11-12

Input shaft bearing

There is a void between input shaft bearing and oil seal. Make this void *60%* full with **GREASE.**

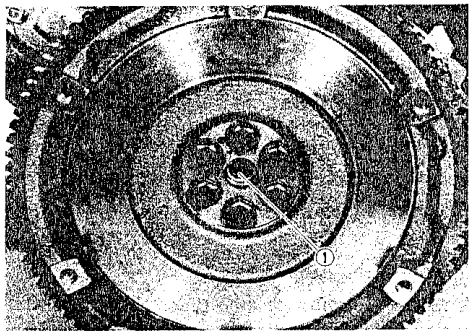


Fig. *11-13* ①*Grease*

Clutch release bearing retainer

Before installing the retainer, apply GREASE to its inner surface.

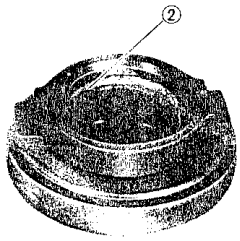


Fig. *11-14* ② *Grease*

Input shaft serration

Apply GREASE to serration part.

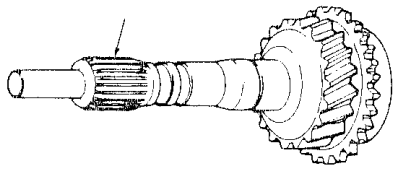


Fig. 11-15

Clutch release arm

Align the two punch marks when installing the clutch release arm on the clutch release shaft.

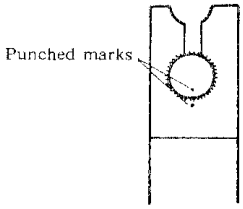


Fig. 11-16

12. GEAR SHIFTING CONTROL

12—1. Description

The movement of the gearshift control lever is transmitted by two (gearshift and gear select) rods to the transmission gearshift shaft arm and gear select shaft arm, and then actuates one of the three fork shafts in the extension case which is selected by the control lever.

When moving the gearshift control lever in the right or left direction as in the gearshift pattern in Fig. 12-2, its movement is transmitted to the gearshift shaft arm as shown by the arrows in the following.

Control shaft→Select No. 1 arm→Select No. 1 rod→Select No. 2 arm →Select No. 2 rod→Gear select shaft arm.

This movement further moves the gearshift shaft lever in the gearshift lever case along the thrust of the gearshift lever shaft to make selection of the position to be shifted in .

When moving the gearshift control lever in the forward or backward direction following the above selection in the right or left direction, its movement is transmitted to the gearshift shaft arm as shown by the arrows in the following.

Control shaft →Shift No. 1 arm→Shift No. 1 rod →Shift No. 2 arm→Shift No. 2 rod→Gear shift shaft arm and then the shift fork shaft is shifted by the gearshift shaft lever in the gearshift lever case.

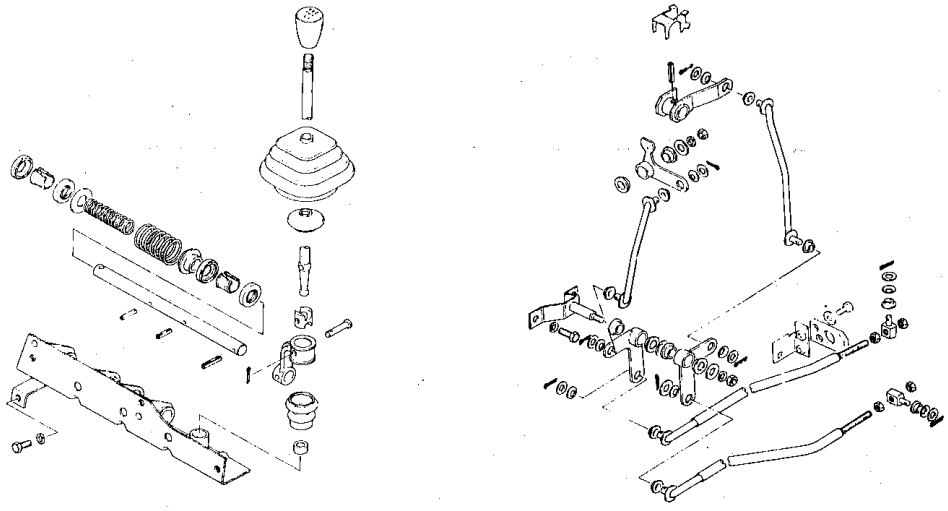


Fig. 12-1

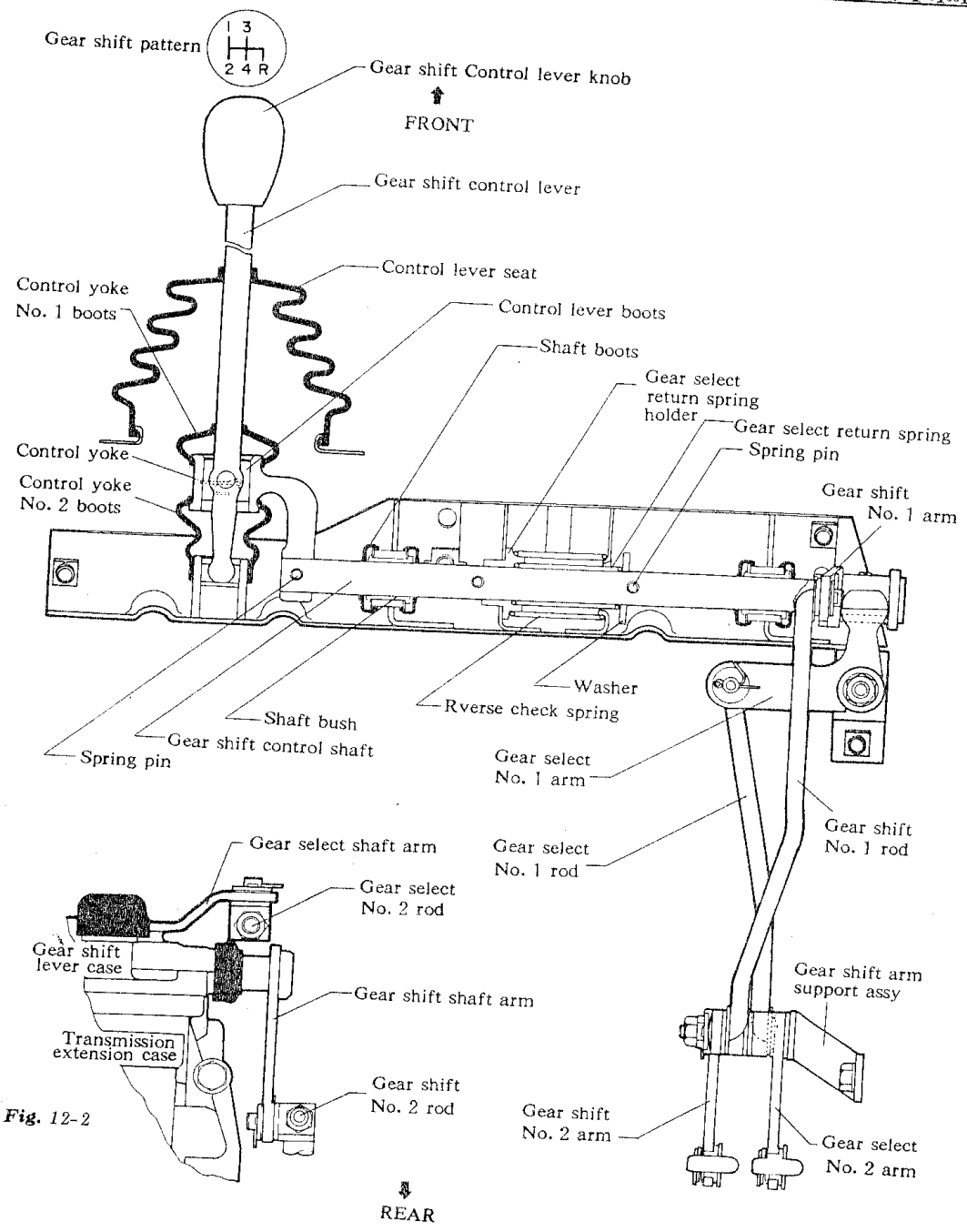

Gear shift pattern
1 3
2 4 R
Gear shift Control lever knob
FRONT
Gear shift control lever
Control lever seat
Control yoke
No. 1 boots
Control lever boots
Shaft boots
Gear select
return spring
holder
Gear select return spring
Spring pin
Control yoke
Control yoke
No. 2 boots
Gear shift
No. 1 arm
Washer
Rverse check spring
Shaft bush
Gear shift control shaft
Spring pin
Gear select
No. 1 arm
Gear shift
No. 1 rod
Gear select
No. 1 rod
Gear select shaft arm
Gear select
No. 2 rod
Gear shift
lever case
Gear shift shaft arm
Gear shift arm
support assy
Transmission
extension case
Gear shift
No. 2 rod
Gear shift
No. 2 arm
Gear select
No. 2 arm
REAR

Fig. 12-2

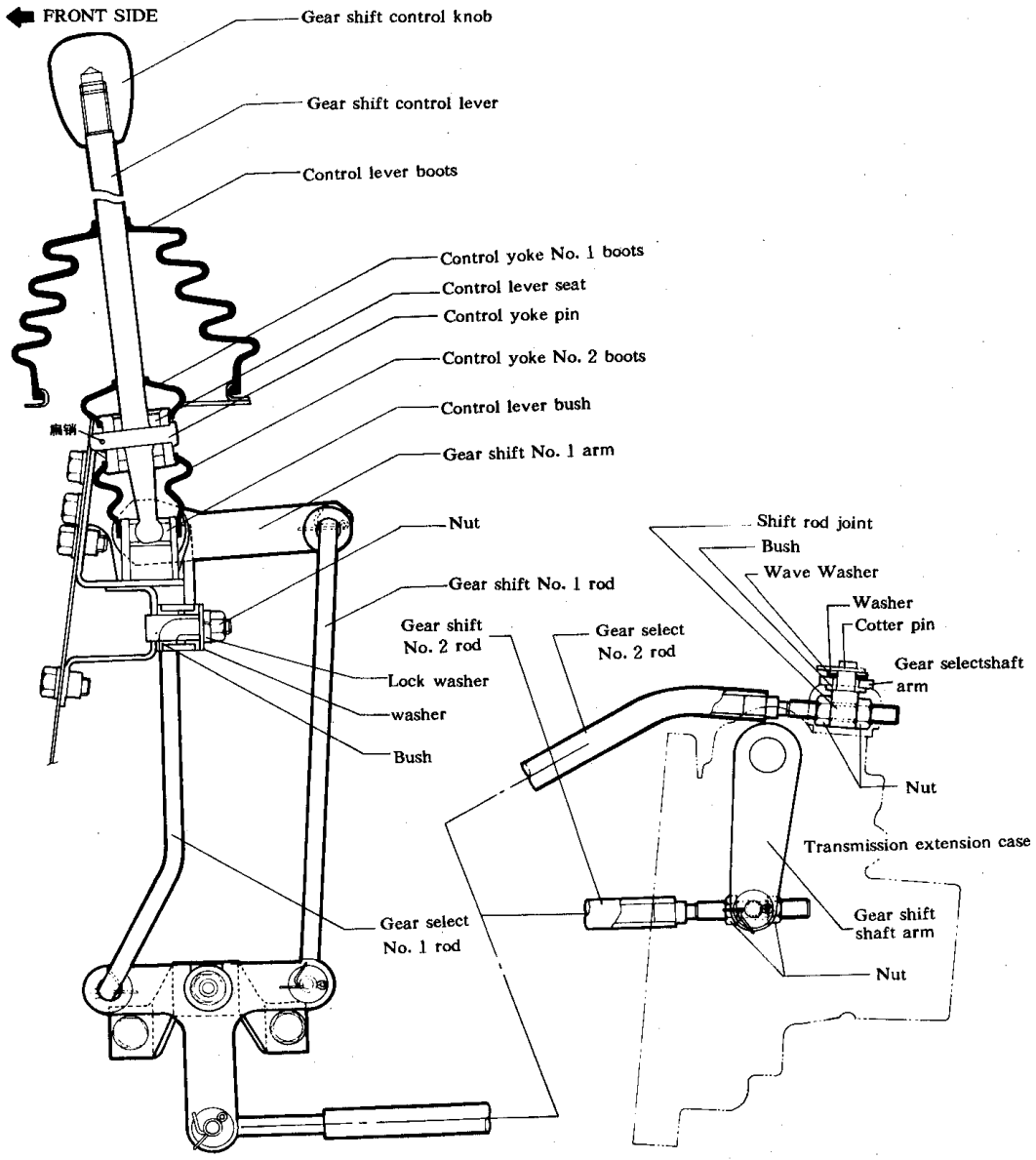

FRONT SIDE
Gear shift control knob
Gear shift control lever
Control lever boots
Control yoke No. 1 boots
Control lever seat
Control yoke pin
Control yoke No. 2 boots
Control lever bush
Gear shift No. 1 arm
Nut
Gear shift No. 1 rod
Gear shift No. 2 rod
Lock washer
washer
Bush
Gear select No. 1 rod
Shift rod joint
Bush
Wave Washer
Washer
Cotter pin
Gear select No. 2 rod
Gear selectshaft arm
Nut
Transmission extension case
Gear shift shaft arm
Nut

Fig. 12-3

12-2. Maintenance Services

Inspection

Check if the gearshift operates properly.

When the gearshift operation is found poor, check the bushes at each joint part of rods for wear and each rod for play before adjusting select No. 2 rod and shift No. 2 rod joints. The defective bush should be replaced.

Also, check if grease has been applied to the sliding part of each seat and bush, and if the rods and shafts move smoothly. If not, correct the defective parts or apply grease where necessary. Refer to Fig. 12-11 to Fig. 12-14 for greasing points.

Adjustment

This adjustment presupposes the above check.

NOTE:
Make sure to set the gearshift shaft arm ④ in the neutral position.

1) Loosen the nuts ⑤ to the extent that they are about 10mm(0. 4 in) away from each side of rod joints ⑥.

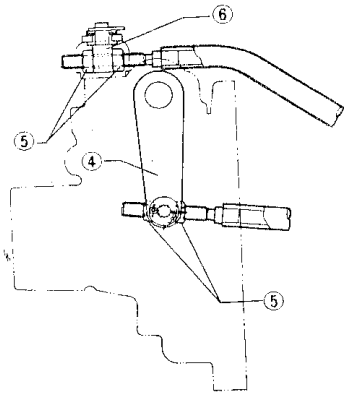


Fig. 12-4

2) Set the gearshift control lever ⑦ tilted toward the front at an angle of about 5° to the vertical.

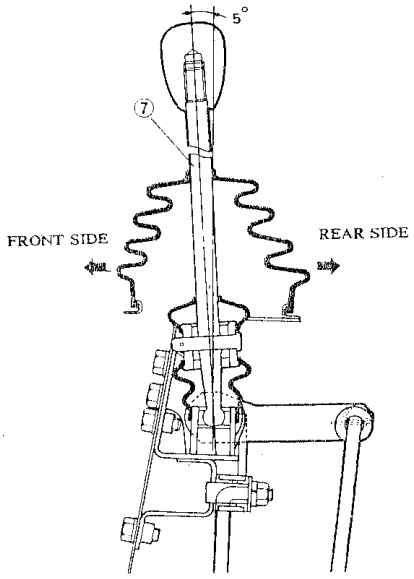


Fig. 12-5

3) Tighten the nuts ⑤ using care not to move any of rods ① and ②, and shaft arms ③ and ④.

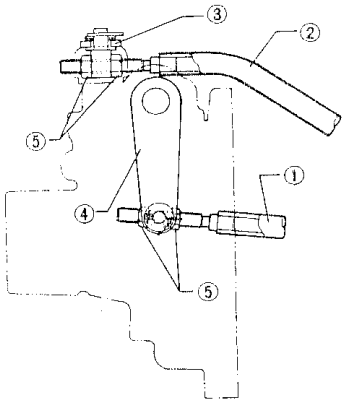


Fig. 12-6

4) Operate the gearshift control lever and check if each shift of the shift pattern is performed smoothly.

NOTE:
When the result of the gearshift operation check necessitates the gearshift control lever to be tilted toward the front, move the nuts ⑤ of the rod ① toward the FRONT side.
On the other hand, when tilting toward the rear is needed, move the nuts ⑤ of the rod ① toward the REAR side.

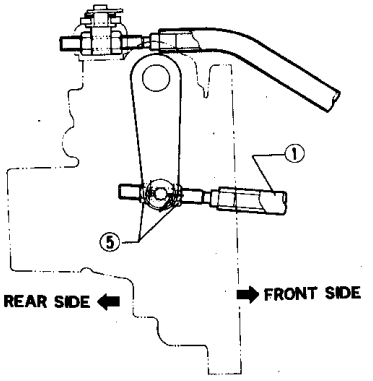


Fig. 12-7

When it is necessary to tilt the gearshift control lever toward the right, move the nuts ⑤ of the rod ② toward the REAR side.
On the other hand, when tilting toward the left is needed, move the muts ⑤ of the rod ② toward the FRONT side.

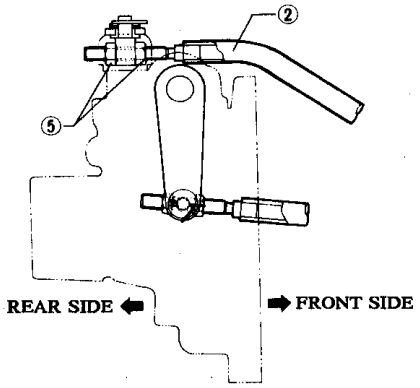


Fig. 12-8

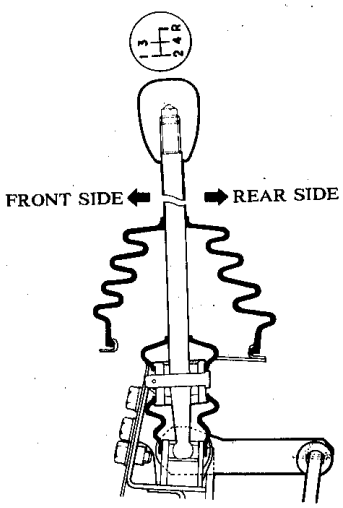


Fig. 12-9

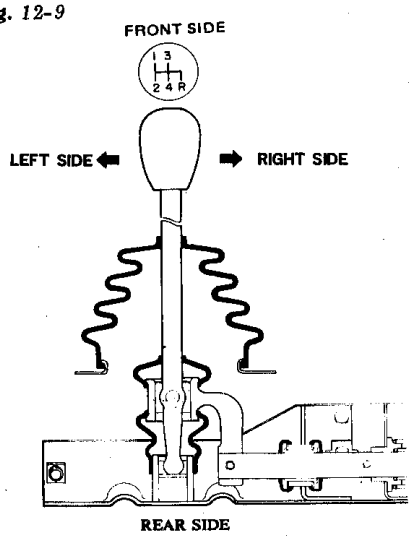


Fig. 12-10

12-3. Installtaion

When reassembling the gearshifting control system which has been disassembled, make sure not to leave out any parts and refer to Fig. 12-2 and Fig. 12-3 for correct installation of each part.

NOTE:
When installing the parts, make sure to apply composite Li base grease ZL-1HSY 1413—763 Ca base grease ZGN-1 ZBE 36001—88, industral vaseline GB6731—86 to the sliding parts illustrated in the following figure.

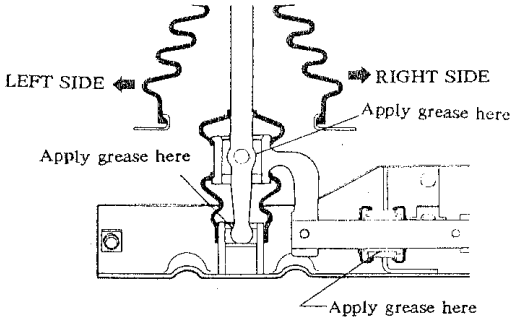


Fig. 12-11

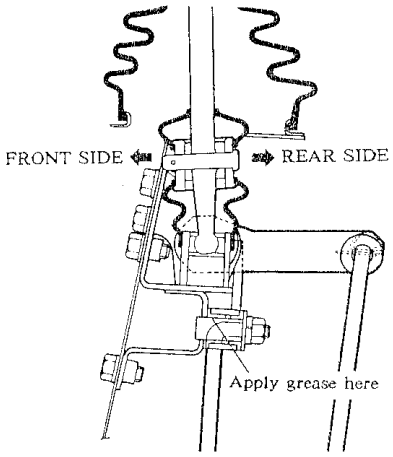


Fig. 12-13

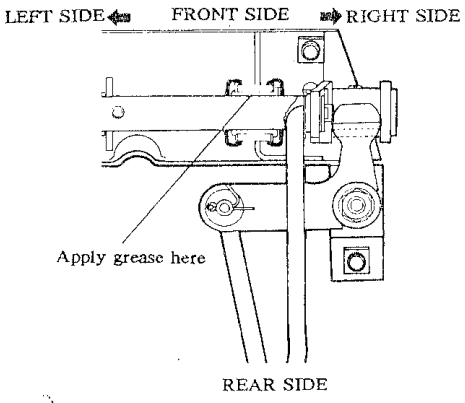


Fig. 12-12

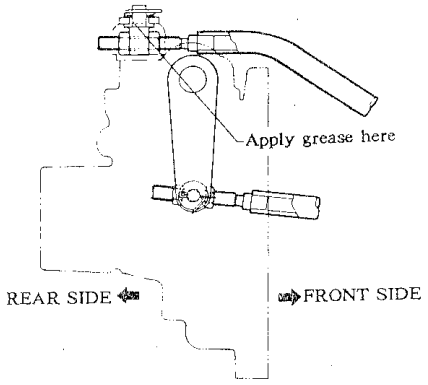


Fig. 12-14

Apply grease to the sliding parts of the bushes installed on the joint part of each rod.

Tightening torque

To be tightened to:	N. M	kg-m	lb-ft
Gear select and shift arm nuts	9～14	0. 9～1. 4	7. 0～10. 0

13. TRANSMISSION

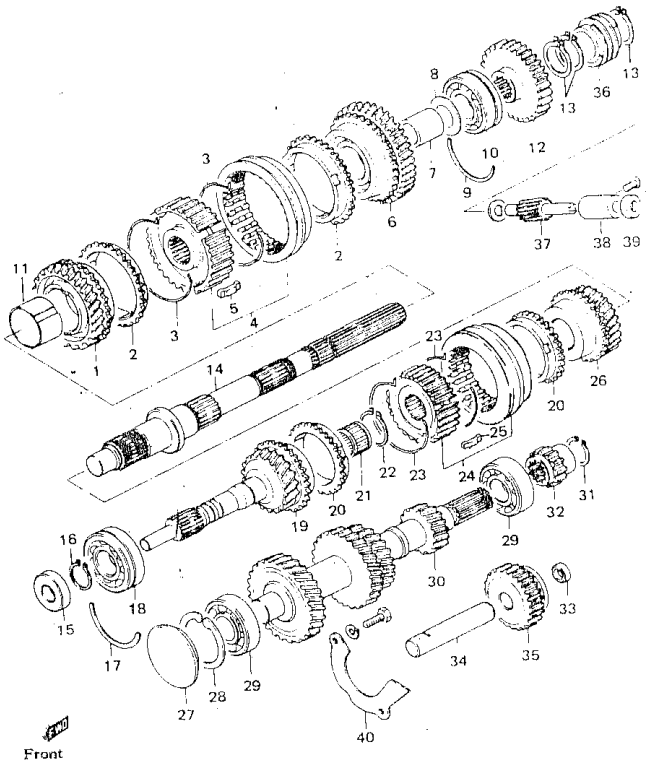
13—1. Description

The transmission is full synchronized and provides four forward speeds and one reverse speed by means of two synchronizers and three shafts-input shaft, main shaft and countershaft. Inputshaft and main shaft are in line, connected rotatably with a needle roller bearing in between. Gears on these shafts are in constant mesh with those of countershaft.

On the main shaft, low-speed synchronizer couples "low" driven gear or "second" driven gear to the main shaft. High-speed synchronizer couples "third" driven gear or input shaft to the main shaft. Reverse idler gear is for clash meshing, and meshes with the reverse idler mounted on the extended portion of the main shaft.

The transmission case is in two-piece construction, consisting of upper case and lower case. The upper case has the three-fork-shaft shifting mechanism built in it. The lower case supports the countershaft. Fitted to the case is an extension case, in which the gears for reverse drive are housed.

The forward section of the transmission case constitutes the housing for the clutch. As viewed from the clutch side, the clutch shaft and transmission input shaft are a single intergral shafting extending into the transmission case. As mentioned above, this shaft is followed by the main shaft, which extends out from the other end of the case and is splined to the universal joint yoke.



1. Second gear
2. Low speed synchronizer ring
3. Synchronizer spring
4. Low speed hub set
5. Synchronizer key
6. Low gear
7. Bush
8. Thrust washer
9. C ring
10. Bearing
11. Bush
12. Reverse driven gear
13. Circlip
14. Main shaft
15. Oil seal
16. Circlip
17. C ring
18. Bearing
19. Input shaft
20. High speed synchronizer ring
21. Needle bearing
22. Circlip
23. Synchronizer spring
24. High speed hub set
25. Synchronizer Key
26. Third gear
27. Piuy
28. Circlip
29. Bearing
30. Countershaft
31. Circlip
32. Reverse drive gear
33. Plug
34. Reverse shaft
35. Reverse idle gear
36. Speedometer drive gear
37. Speedometer driven gear
38. Bush
39. Oil seal
40. Stop plate

Fig. 13-1

13—2. Flow of Drive Through Transmission

How drive flows will be explained for each shift position:

Low speed drive

Low driven gear on the main shaft is free from this shaft and merely rotates around it, as driven from the low drive gear of the countershaft. Shifting the lever into "low" causes low-speed gear shifter fork to push low-speed synchronizer toward low driven gear and, through the dog teeth, mesh it with the gear, thus coupling the gear to the main shaft.

Under this condition, drive flows from input shaft to countershaft through one stage of speed reduction, and then from countershaft to main shaft, through another stage of speed reduction.

Second speed drive

Shifting the lever into "second" causes the same low-speed gear shifter fork to push low-speed synchro-

nizer to the other direction, that is, toward second driven gear and mesh it with this gear, thereby coup ling the gear to the main shaft. Under this condition, speed recuction takes place twice, as in the low speed drive described above, first between the gear of input shaft and that of countershaft and secondly between second drive gear (of countershaft)and second driven gear (on the main shaft).

Third speed drive

Shifting the lever into "third" actuates high-speed shifter fork to engage high-speed synchronize with third driven gear on the main shaft. This gear, like low and second driven gears, is free on the shaft and merely spins as driven by third drive gear of countershaft when the gearshift lever is any other position. Just as in the case of low and second speed drives, drive flows from countershaft to main shaft through third drive and driven gears and high-speed synchronizer.

Top speed drive

Shifting the lever into "top" actuates the same high-speed shifter fork to engage high-speed synchronizer with the input shaft gear through dog teeth, thereby coupling input shaft direct with mainshaft. No speed reduction is involved in this flow of drive; engine crankshaft drives main shaft through input shaft.

Reverse drive

Shifting the lever into "reverse" actuates reverse gear shifter fork to mesh the reverse idle gear into the reverse gear on the main shaft. This is a "clash" meshing action, by which the idler gear comes into between the reverse drive gear of countershaft and the gear on the main shaft.
Drive is from input shaft to countershaft and then to main shaft through reverse idle gear. Two stages of speed reduction and reversal of rotary direction are involved in this drive.

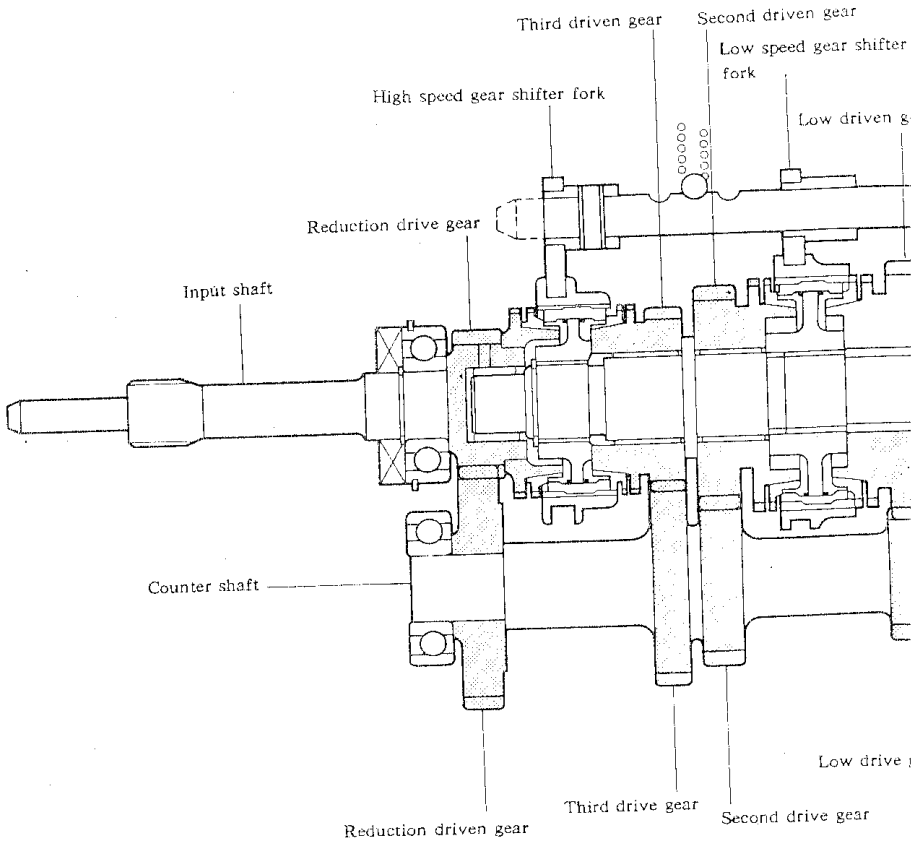
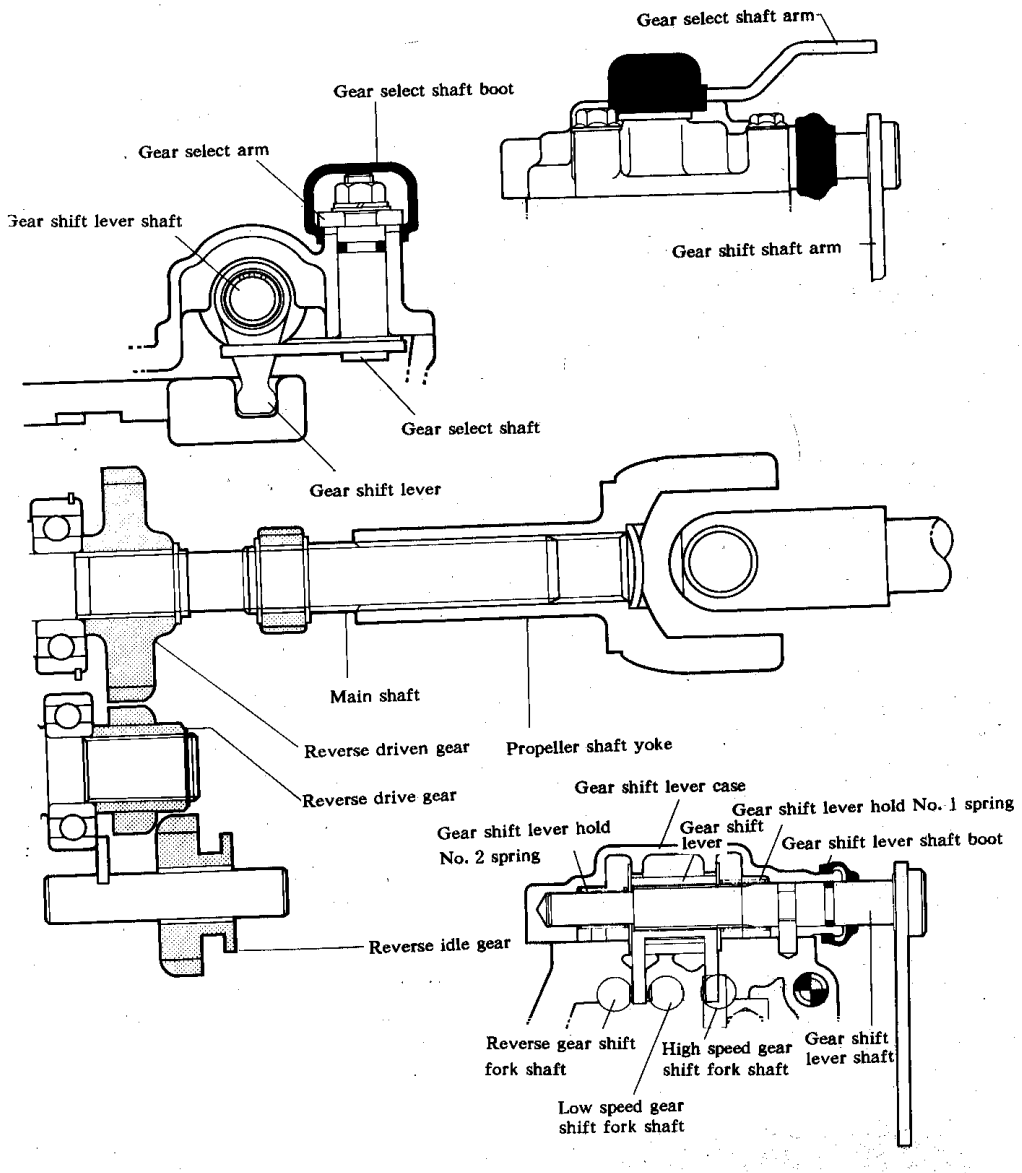

Third driven gear
Second driven gear
Low speed gear shifter fork
High speed gear shifter fork
Low driven g
Reduction drive gear
Input shaft
Counter shaft
Low drive
Reduction driven gear
Third drive gear
Second drive gear

Fig. 13-2


Gear select shaft arm
Gear select shaft boot
Gear select arm
Gear shift lever shaft
Gear shift shaft arm
Gear select shaft
Gear shift lever
Main shaft
Reverse driven gear
Propeller shaft yoke
Reverse drive gear
Gear shift lever case
Gear shift lever hold No. 1 spring
Gear shift lever hold No. 2 spring
Gear shift lever
Gear shift lever shaft boot
Reverse idle gear
Reverse gear shift fork shaft
High speed gear shift fork shaft
Gear shift lever shaft
Low speed gear shift fork shaft

13—3. Transmission Gear Ratio

Primary gear ratio		32/20				
Primary speed ratio		1.600				
Shift position		Low	Second	third	Top	Reverse
Secondary ratios	Gear ratio	30/14	29/22	25/29	—	27/12
	Speed ratio	2.143	1.318	0.862	—	2.250
Overall speed reduction ratio		3.428	2.108	1.379	1.000	3.600

13-4. Dismounting

1) Lift the rear end of the machine by jacking, and support it with safety stands.
2) Drain out oil in the transmission.
3) Disconnect the battery cord from the negative terminal of the battery, and remove cord clamps.
4) Disconnect propeller shaft from the differential, and draw its forward portion out of the transmission.
5) Disconnect, speedometer drive cable from the extension case.
6) Open the backing lamp lead wire (RED) at its coupler.
7) Disconnect gearshift control rods from gearshift levers by breaking the rod-to-lever joints.
8) Disconnect clutch wire from the clutch lever.
9) Remove starter motor from transmission case.
10) Remove the clutch housing lower plate.
11) Remove the bolt and nuts securing the transmission case to the engine.
12) Support the engine by jacking.
13) Take up the weight of the transmission by putting the lifting jack to its bottom.
14) Remove transmission mounting bolts.
Make sure that the transmission is clear of all connections. Lower it to the floor.

13-5. Disassembly

Separating the upper case from the lower case

Remove clutch release bearing from transmission input shaft.

Remove the bolts securing gearshifting case and take off the case from the transmission case.

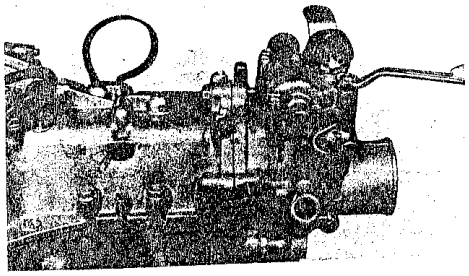


Fig. 13-3

Remove the bolts securing the extension case to the transmission case, and detach the extension case and mounting bracket.

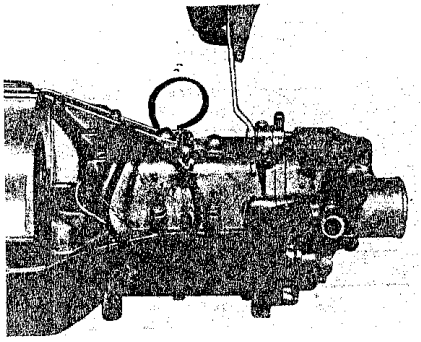


Fig. 13-4

Remove the bolts fastening the upper and lower cases together, separate the two, and take out the main shaft assembly. A steel bar, similar in shape to screwdriver, may have to be used to pry the two cases apart, as shown. In such a case, do not stick the bar too far into between the two mating faces or the faces may become damaged.

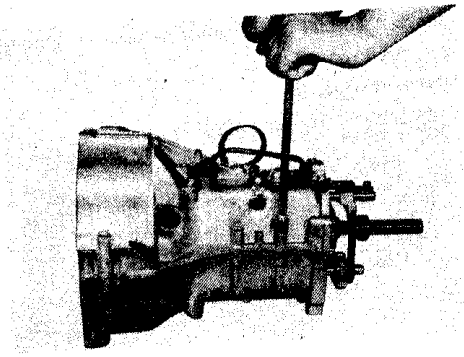


Fig. 13-5

Removing the countershaft

Remove the 2 bolts securing reverse gear shaft stopper plate, and take off the stopper plate and reverse gear shaft.

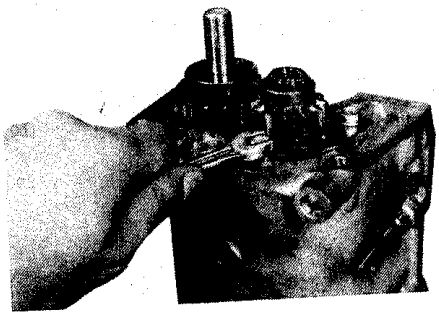


Fig. 13-6

Remove the circlip retaining the reverse gear on countershaft, using the circlip remover Ⓐ, and slide the reverse gear off countershaft.

Circlip Remover Ⓐ

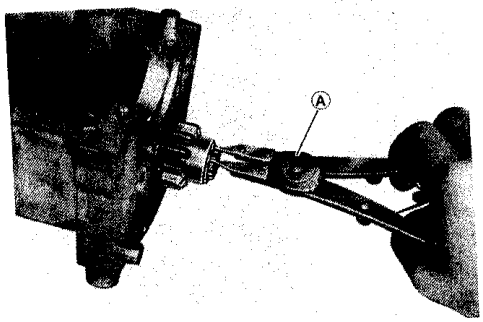


Fig. 13-7

Remove the rubber plug on countershaft. Remove the circlip retaining the countershaft bearing, as shown.

Circlip remover Ⓑ

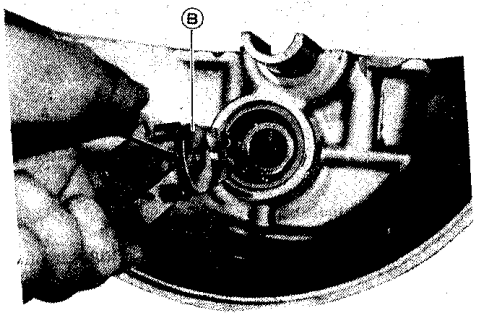


Fig. 13-8

Pull off countershaft to the low gear side, remove the bearing, and take the countershaft assembly out of the case. Two special tools must be used for this removal:

Bearing installer Ⓒ

Bearing puller Ⓓ

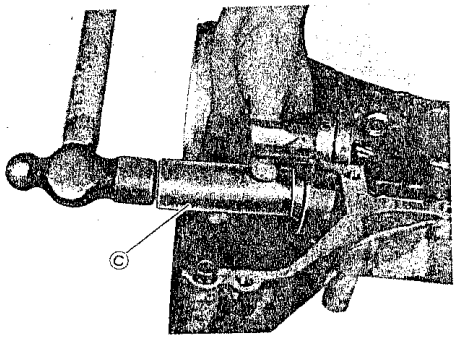


Fig. 13-9

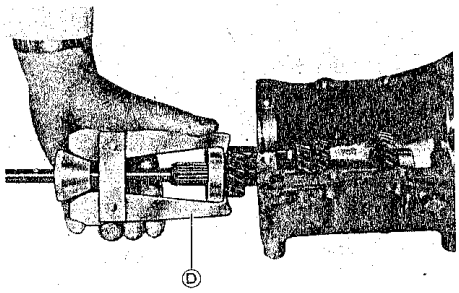


Fig. 13-9-1

Removing the main shaft and input shaft

Take out the input shaft by hand, taking care not to let the high-speed synchronizer rings drop.

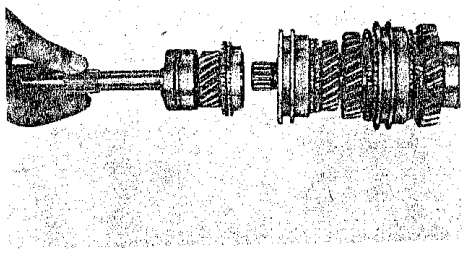


Fig. 13-10

Remove the circlip retaining the hub or high-speed synchronizer sleeve, and slide off the sleeve hub and third driven gear from main shaft. A special tool Ⓔ must be used in removing the circlip:

Circlip remover Ⓔ

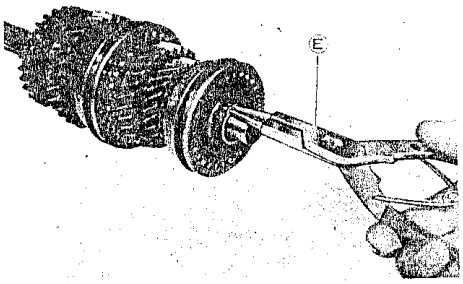


Fig. 13-11

Remove the circlip retaining the levers gear on main shaft. Remove this gear and main shaft bearing. Be sure to use the circlip remover.

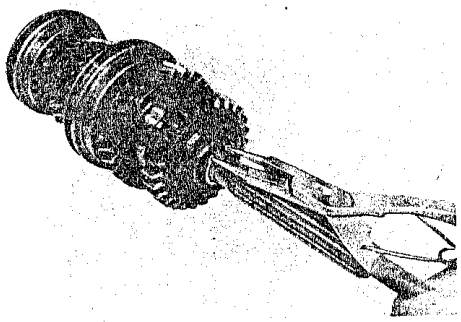


Fig. 13-12

From main shaft, take off the low driven gear, low-speed synchronizer sleeve hub and second driven gear. Be sure not to allow the cynchronizer rings to drop down when the sleeve hub is coming off.

Spring pin remover Ⓐ

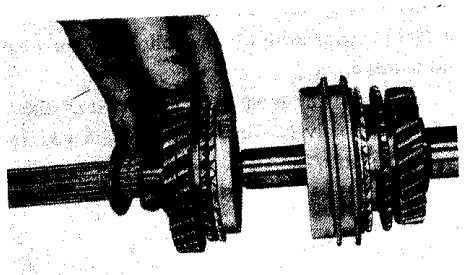


Fig. 13-13

Removing the shifter fork shafts and forks

Before starting the removal work, make sure that all the shifter fork shafts in place are in neutral position. First, removing the stopper plate for shifter fork shafts by removing the two bolts securing this plate.

It is important that the three shifter fork shafts be kept in neutral position at this time in order to make sure that the interlock balls between two adjacent shafts are seated fully in the dents of respective shafts. If any of these interlock balls is off the dent, some of the fork shafts will refuse to come out when pulled.

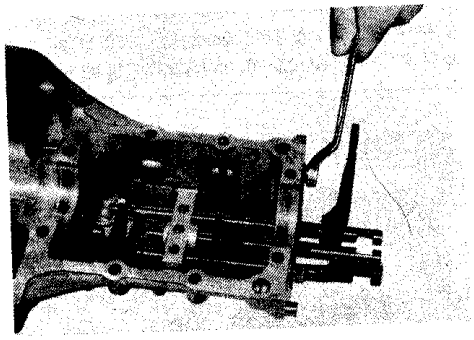


Fig. 13-14

Using the spring pin remover (special tool), draw out the spring pin on reverse gear shifter fork, and pull out the shifter fork shaft. As this shaft comes out, the locating ball and spring will jump out of the hole; do not let them fly away.

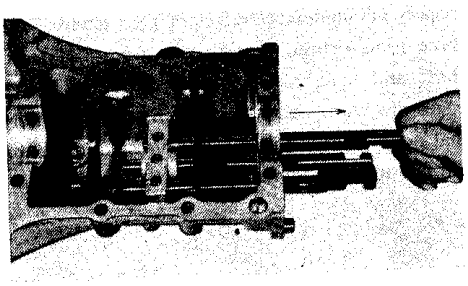
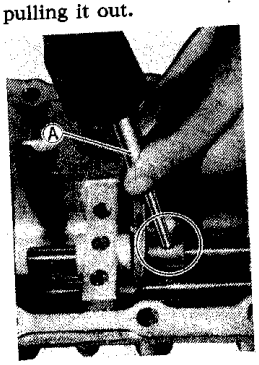


Fig. 13-15

Move the low-speed shifter fork shaft into the position for "second". This will allow the spring pin to shift into the dent provided in the case. Using the same special tool, mentioned above, draw out the spring pin and pull out the fork shaft. As in the case of above, be careful not to let the steel ball and spring fly away.

Having thus far removed the reverse gear shifter fork shaft and low-speed shifter fork shaft, you are now to remove the high-speed shifter fork shaft, as follows: Move this fork shaft into the position for "third", so that the spring pin will shift into the dent provided in the case; draw out the spring pin by using the spring pin remover, mentioned above; and remove the shaft by pulling it out.



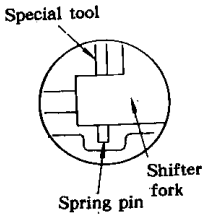


Fig. 13-16

13-6. Maintenance Services

Reverse gears and idle gear

Inspect the chamfered edges of gear teeth of the three gears-driving and driven gears (of main shaft and countershaft) and idle gear. If the edges are worn badly, replace the gears. Abnormal noise of gear slipping in reverse drive is often due to worn tooth edges of these gears.

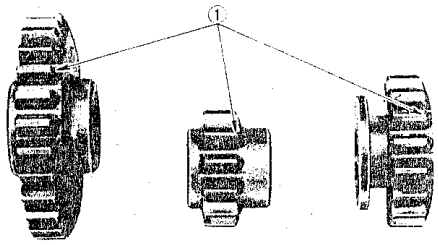


Fig. 13-17 ① Chamfered

Countershaft and its bearings

If any of the contershaft gears is found with chipped or broken teeth, replace the countershaft. Check each bearing by spinning its outer race by hand to "feel" the smoothness of rotation. Replace the bearing if noted to exhibit sticking, resistance or abnormal noise when spun or rotated by hand.

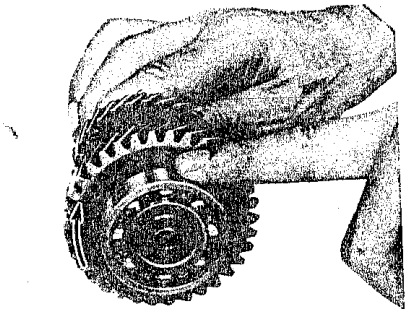


Fig. 13-18

Input shaft

Referring to Fig. 13-19, inspect the cone ① and toothed ring ② for wear and damage.

Inspect the gear teeth ③ and splines ④ for wear and damage.

If any part of the input shaft inspected as above is found excessively worn or badly damaged, replace the shaft.

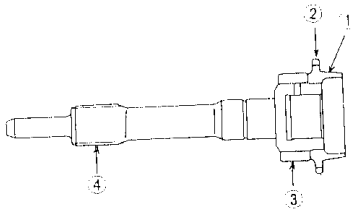


Fig. 13-19

Combination of gear and synchronizer ring

Fit the ring to the cone of the gear (input gear, or "third", "second" or "low" gear), and measure the clearance between the two at the peripheral teeth, as shown in Fig. 13-20. If the clearance is noted to have reached or exceeded the service limit, replacement is necessary.

	Standard	Service limit
Clearance between gear and ring	0.8~1.2mm (0.03~0.05 in.)	0.5mm (0.02 in.)

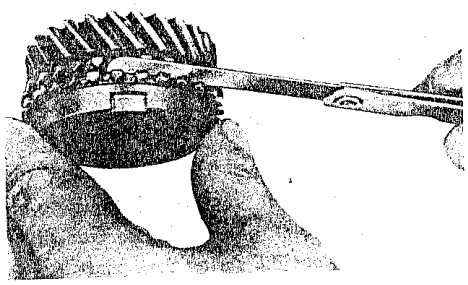


Fig. 13-20

Inspect the external cone (of the gear) and inter-

nal cone (of the ring) for abnormal wear. Be sure that the contact patterns on these surfaces indicate uniform full-face contact, and that the surfaces are from any wavy wear. A badly worn member must be replaced.

Proper synchronizing action on gear shifting can be expected when the ring-to-gear clearance (Fig. 13-20) and the condition of cone surfaces, among other things, are satisfactory.

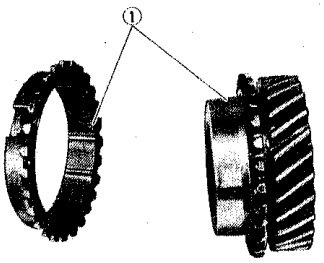


Fig. 13-21 ① Checking contacting surface.

Chamfered tooth ends of ring (external teeth) and sleeve (internal teeth)

Synchronizer ring and hub have three slots each, in which the keys are carried as backed by expanding springs, so that the hub and its two rings, one on each end, are capable of running together. Since the sleeve is engaged by its internal teeth with the hub, as if the two were splined together, the sleeve too runs with the hub and rings.

In meshing action, the sleeve is pushed (by the shifter fork) to one side, so that is slides axially on the hub, pushing the ring toward the cone surface of the gear. This push is transmitted by the three keys, which are lightly gripped by the sleeve.

By the friction between the gear cone and the ring cone (internal), the ring begins to rotate but is opposed by the hub because of the keys. In other words, the ring is at this time twisted, while the seleve is advancing further to push the ring fully against the gear cone. Since the ring is unable to slide along any further, the sleeve lets go of the keys and rides over to the ring. At this moment, the initial contact between the chamfered ends of teeth of the ring and those of internal teeth of the sleeve occurs. This contact is such that the internal teeth of the sleeve align themselves to those of the ring. When the sleeve advances and slides into the ring, the ring will be rotating nearly with the speed of the gear, so that the sleeve is enabled smoothly to slide over into the clutch teeth of the gear.

The initial contactor mesh between sleeve and ring is determined by the widths of key and slot or, to say the same thing, the key clearance in the slot, and is prescribed to extend at least a third (1/3) of the chamfer.

With the synchronizer properly assembled on the shaft, push in and twist each synchronizer to see if the one-third mesh occurs or not; if not, it means that the overall wear (which is the sum of the wears of slots, keys and chamfered tooth ends) is excessive and, in such a case, the entire synchronizer assembly must be replaced.

Mesh of chamfered tooth ends of synchronizer ring and hub	Contact extending about 1/3 of chamfered face from apex

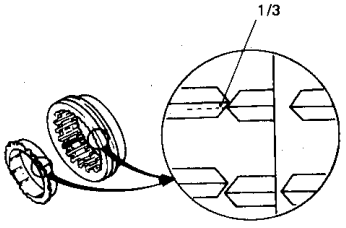


Fig. 13-22

Synchronizer rings

Inspect each synchronizer ring for wear of its

key slots by measuring the width of each slot. If the width reading exceeds the limit, replace the ring.

Key slot width of synchronizer ring	Standard	Service limit
	9.6mm (0.38 in.)	9.9mm (0.39 in.)

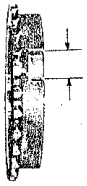


Fig. 13-23

Fork shaft locating springs

Locating spring are used to arrest the three shifter fork shafts. If "gears slipping out of mesh" has been complained, check these springs for strength by measuring their free lengths, and replace them if their free lengths are less than the service limits.

Spring Free length	Standard	Service limit
	19.5mm (0.767 in.)	17.0 mm (0.669 in.)

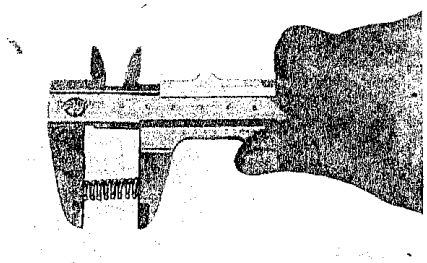


Fig. 13-24

Extension case bush

Check the bush press-fitted into the extension case for wear by measuring the radial clearance between bush bore and sliding yoke. If the sliding yoke is capable of rattling in the bush because of advanced wear it will cause the propeller shaft to rattle. For this reason, an extension case found to allow its sliding yoke to rattle in excess of the service limit must be replaced; replacement of the bush alone is not permissible.

Rattle of sliding yoke in extension case bush	Standard	Service limit
	0.02~0.06mm (0.0008~0.0024 in.)	0.1 mm (0.004 in.)

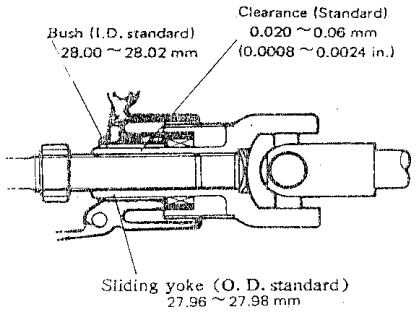


Fig. 13-24-1

Greasing points (Grease ZN-3 GB492-77)

Clutch release shaft	Sliding part against bush
Clutch release yoke lever	Sliding part of arm tip
Clutch release bearing retainer	Inner groove of retainer
Input shaft oil seal	Lip groove part

Extention oil seal	Lip groove part
12ZQ,K9ZQF Ⅱ Engine rear driven gear oil seal	

Lubrication points

Transmission gears	Sliding part against bush or shaft
Bearing	Balls
Gear shifter shaft	Sliding part against case and sleeve
Gear select shaft	Sliding part against case
O ring	All around

(Gear oil API G6-4 SAE 80W/90 or high grade machine oil SAE 15W/30 (winter) SAE 20W/30 (summer)

13—7. Important Steps in Installation

Tightening torque

To be tightened to:	N. M	kg-m (lb-ft)
Transmission case bolt	15～20	1. 5～2. 0 (11. 0～14. 5)
Oil drain plug and level plug	30～50	3. 0～5. 0 (22. 0～36. 0)
Extension case bolt	15～20	1. 5～2. 0 (11. 0～14. 5)
Rear mounting bolt	15～20	1. 5～2. 0 (11. 0～14. 5)
Gearshift lever case bolt (8mm)	9～12	0. 9～1. 2 (7. 0～8. 5)
Gearshift lever case bolt (6 mm)	6～10	0. 6～1. 0 (4. 3～7. 0)
Bolt on stopper plate for shifter fork shafts	15～20	1. 5～2. 0 (11. 0～14. 5)

Input shaft and main shaft

When assembling the two synchronizers on main shaft, be sure to position the hub of each correctly as shown in Fig. 13-25.

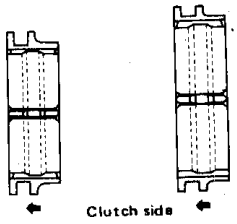


Fig. 13-25

Care must be exercised in positioning the sleeve of each synchronizer. Be sure to bring the groove for admitting the fork to the clutch side.

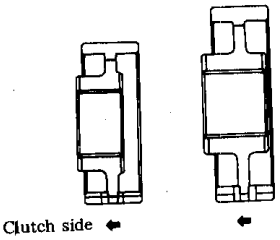


Fig. 13-26

After putting on each synchronizer, be sure that the three keys mounted on the hub fit snugly into the slots provided in the ring.

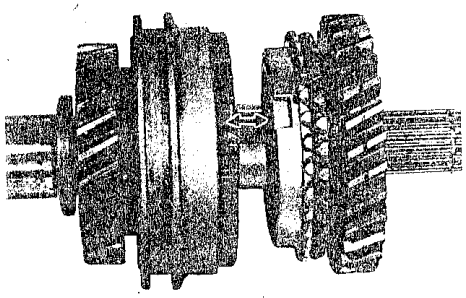


Fig. 13-27

Shifter forks and shafts

When feeding each shifter fork onto its shaft, be sure to bring the boss (in which the hole for admitting the spring pin is provided) to the extension case side.

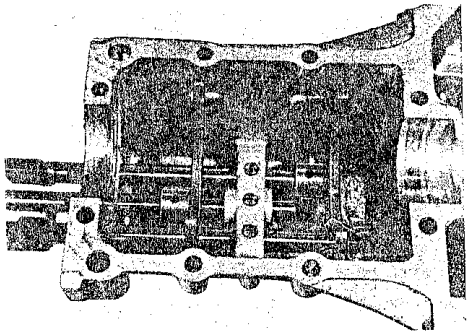


Fig. 13-28

These coil springs are for keeping the locating steel balls pushed down against the fork shafts (REVERSE, HIGH and LOW) for the purpose of arresting these shafts at respective operating positions.

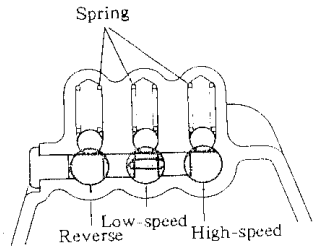


Fig. 13-29

The shifter fork shafts are to be installed sequentially. First to be put in place is high-speed shaft, followed by low-speed shaft and then reverse shaft. The sequence is indicated in the ascending order of numbers in Fig. 13-30.

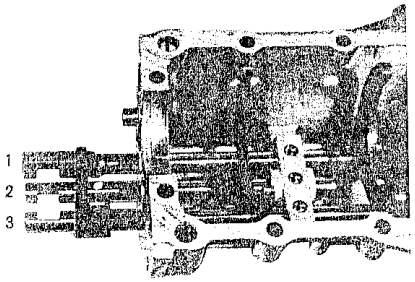


Fig. 13-30

The hole for installing the interlock steel balls is provided in the side wall, next to the reverse shifter fork shaft, of the transmission case. Be sure to feed in one ball after another, positioning each ball between two adjacent shafts, as shown in Fig. 13-31.

NOTE:
Be sure to put in the pin for preventing two shafts from getting shifted at the same time. This pin goes into the hole provided in the low-speed shaft.

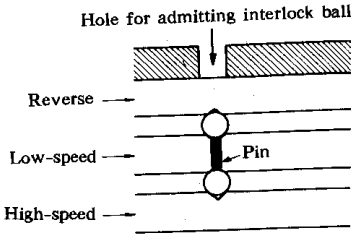


Fig. 13-31

Reverse gears and idle gear

The two reverse gears have their teeth chamfered on one end, and the reverse idle gear is similarly chamfered. When mounting the reverse gears on main shaft and countershaft, respectively, be sure to bring the chamfered end to the outboard side. The chamfered end of the idle gear, however, must face inwardly, as shown in Fig. 13-32.

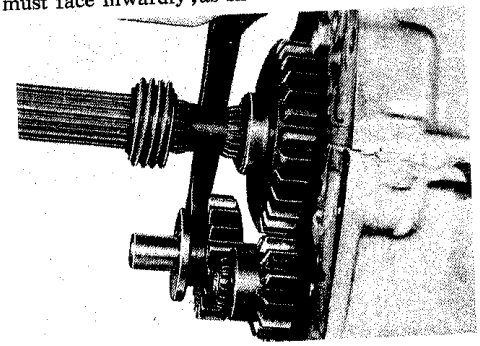


Fig. 13-32

Input shaft and main shaft installation

Before installing the input and main shaft assembly on the lower case, be sure fit the "C" rings ① and dowel pins ② into the case.

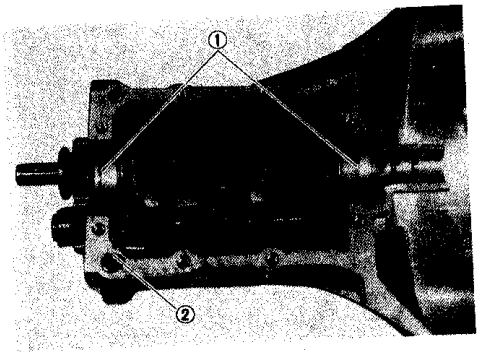


Fig. 13-33

Putting together upper and lower cases

Clean the joint faces, removing any foreign matters adhering to these faces, and then apply the liquid (Anaerobic bond GY 168) to the point faces, coating each face uniformly with the compound and, a few minutes after this application, match the two cases together.

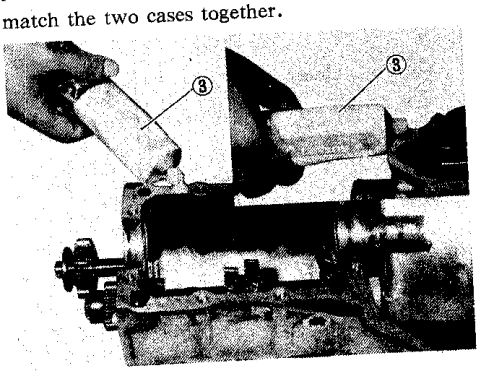


Fig. 13-34

When bringing the two cases into match as shown in Fig. 13-35, be sure to guide each shifter fork into the groove of its synchronizer sleeve. After putting the upper case on the lower case, tighten the joint bolts uniformly and sequentially so as to equalize the joint pressure all around.

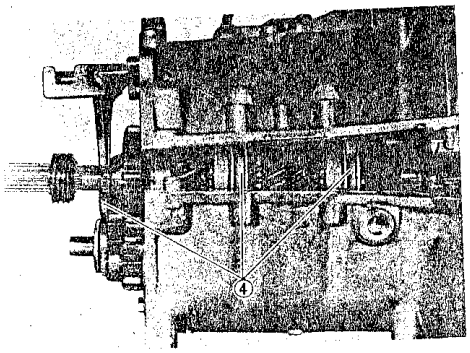


Fig. 13-35 ④ Shifting forks

Extension case oil seal

When installing this seal, be sure to position it so that its spring ① part comes on the inner side.

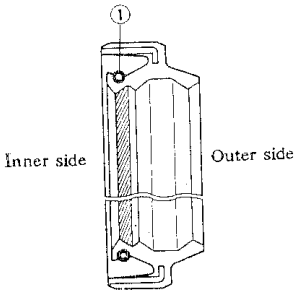


Fig. 13-36

Transmission oil

The oil capacity of the transmission and the oil specification are as follows:

Oil capacity	1.0 litres (2.1/1.8 US/Imp. pt.)
Oil specification	GEAR OIL API G6-4 SAE 80W/90 or high grade machine oil SAE 15W/20 (winter) SAE 20W/30 (summer)

Fig. 13—37 ① Oil filler plug ② Oil drain plug

14. PROPELLER SHAFT

14—1. Description

The propeller shaft is a three-part combination consisting of a shaft and two universal joints. It is connected to the differential pinion through flanged connection and to the transmission output (main) shaft through a sliding spline joint.

The outer yoke ③ of the front universal joint has its shank internally splined. The splined end of transmission shaft fit into the shank. The outer yoke of the rear joint is flanged; this flange is bolted to the flange ①, which is splined onto the forward end of the differential pinion.

The spider with four journals in each universal joint is fitted with four needle roller bearings, each bearing being press-fitted and locked in place by punching. Because of the four bearings being locked by punching, these universal joints are not meant to be overhauled.

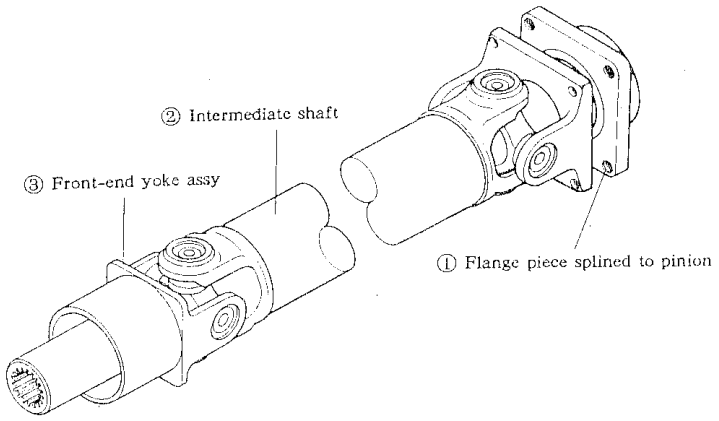


Fig. 14-1

14-2. Removal

1) Lift the rear end of the machine by jacking, with the jack head put up against the rear axle.
2) Remove four bolts in the flanged connection and separate the two flanges apart, thus severing the propeller shaft from the differential.
3) Pull the forward end off the transmission; the front-end yoke will slide off transmission shaft inside.

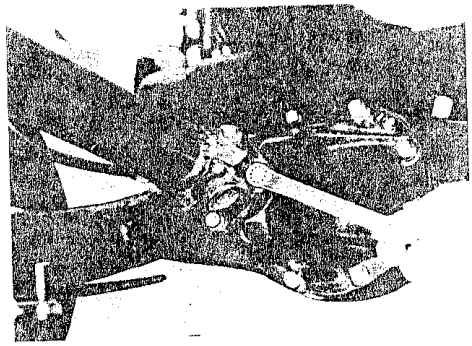


Fig. *14-2*

14-3. Maintenance Service

Universal joint noise

If the universal joints are suspected of producing chattering or rattling noise, inspect them for wear. Check to see if the cross spider rattles in the yokes or if the splines are worn down.

The noise coming from universal joint can be easily distinguished from other noises because the rhythm of chattering or rattling is in step with cruising speed.

The noise is pronounced particularly on standing start or in the coasting condition (when the braking effect of the engine is showing in the frive line).

The remedy for a propeller shaft whose universal joints are making noise is to replace the whole shaft assembly.

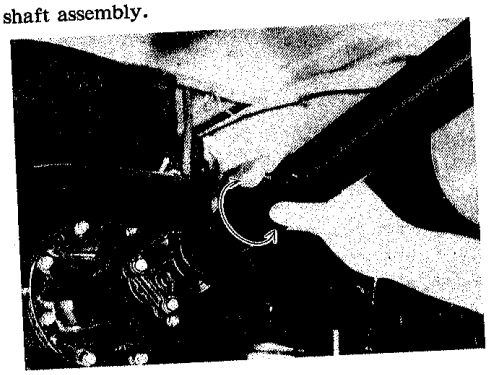


Fig. 14-3

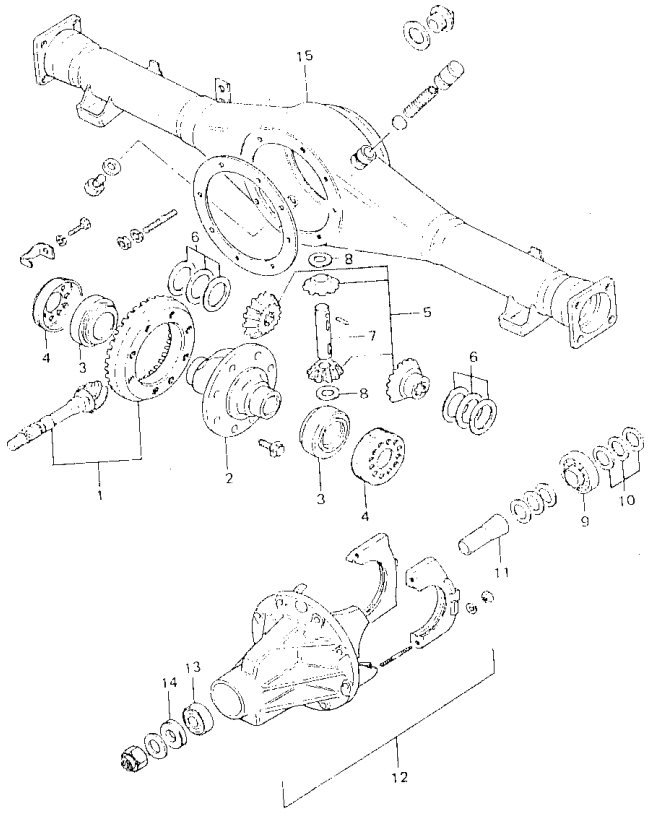
14-4. Installation

Tightening torque for universal joint flange bolts	15～25 N. M 1. 5～2. 5 kg-m (11. 0～18. 0 lb-ft)

15. DIFFERENTIAL

15-1. Description

The components of the rear axle are shown in the exploded view, below. The bevel gear drive is of hypoid design; pinion and gear have hypoid gear teeth. This means that the pinion is located slightly below the center of the bevel gear to permit the car body to be lowered in design, and that some wiping or sliding action occurs in tooth meshing between pinion and gear. Here lies the reason why use of hypoid gear oil is specified for the rear axle.



1. Bevel gear &pinion set
2. Differential case
3. Side bearing
4. Bearing adjuster
5. Differential gear set
6. Thrust washer
7. Side pinion shaft
8. Thrust washer
9. Rear bearing
10. Shim
11. Spacer
12. Differential carrier set
13. Front bearing
14. Oil seal
15. Rear axle housing

Fig. 15-1

15-2. Removal

1) Loosen the hub nuts of both wheels, and lift the rear end by jacking. Support the rear axle housing with safety stands to keep the rear end in lifted condition.
2) Remove the oil drain plug to drain out the oil in the differential housing.
3) Remove hub nuts and take off both wheels.
4) Disconnect the propeller shaft by undoing the bolted joint at the cross joint flange yoke.
5) Remove the brake drum of each axle shaft by using two 6mm bolts.
6) Disconnect brake pipe from each wheel cylinder.
7) Remove brake shoes from backing plate.
8) Remove the 4 bolts securing each backing plate.
9) Install the special tool Ⓐ Front brake drum and rear axle remover by utilizing the rear hub bolts. Using the sliding hammer Ⓑ draw out the axle shaft.

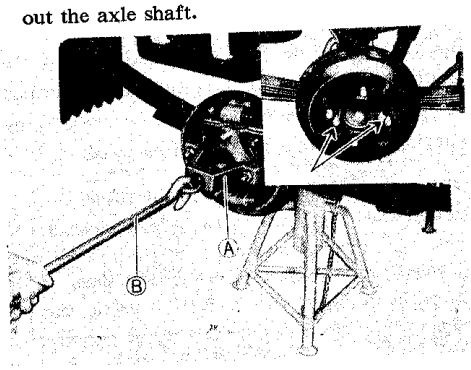


Fig. 15-1-1

10) The two axle shafts having been drawn out, remove the nuts securing the differential carrier assembly to the housing, take the assembly off the housing.

15-3. Disassembly

Lock the flange immovable, and remove the nut from the end of the bevel pinion shank.

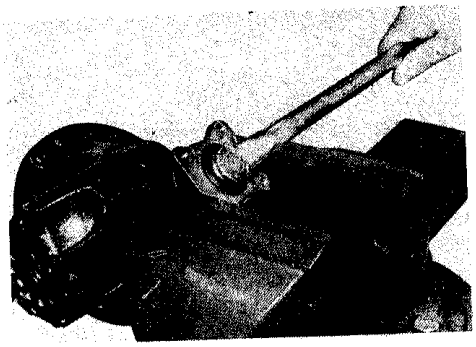


Fig. 15-2

Scribe marks on each cap bolted to the saddle portion of the carrier case and holding down the side bearing. The marks are to identify the cap. This means that there are right and left caps, so identified and so handled at the time of reassembly.

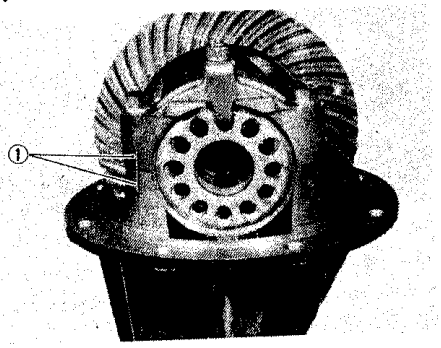


Fig. 15-3 ①*Scribed match marks*

Remove the two bearing caps, right and left, and lift the differential case assembly off the carrier case, after loosening stopper bolts②.

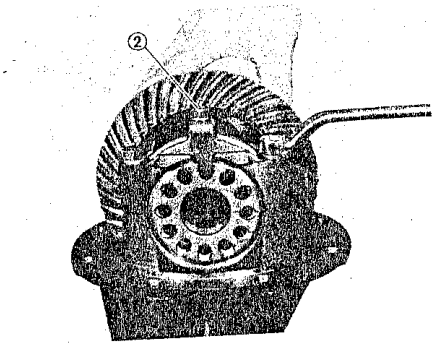


Fig. 15-4

Remove the bolts fastening the bevel gear to the differential case, and take off the bevel gear.

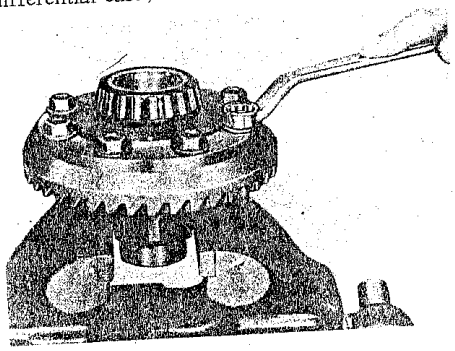


Fig. 15-5

Draw out the side pinion shaft, as shown, and remove side pinions, side gears and thrust washers.

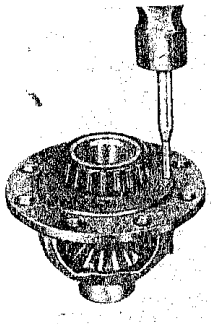


Fig. 15-6-1

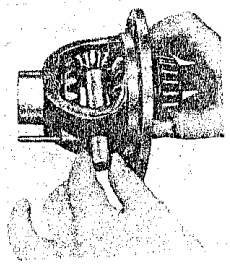


Fig. 15-6-2

Using the special tools indicated below, extract the side bearing from each differential case half.

Bearing puller(Ⓐ)

Side bearing removing jig Ⓑ

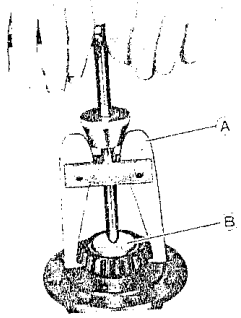


Fig. 15-7

15-4. Maintenance Services

Side gear backlash

Use soft fuse stock in checking the backlash. After flattening the fuse stock according to the standard practice of backlash checking, measure the thickness of the fuse stock, and compare the reading with the backlash specification indicated below. Adjust the backlash, as necessary, by varying the thickness of the thrust washer.

Side gear backlash specification	0.05～0.15mm (0.002～0.006in.)
Available thrust washer sizes (thickness)	0.8, 1.08&1.2mm (0.03, 0.04&0.05in.)

NOTE:
When a fuse stock to measure the differential side gear backlash is not available, measure the side gear thrust play. If it is 0.25mm (0.0098in.) at the maximum, an acceptable backlash value is obtained.

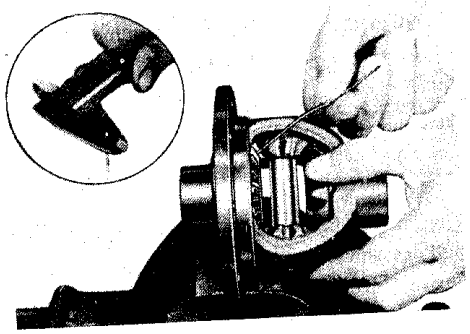


Fig. 15-8

Determination of shim thickness for bevel pinion

The amount of shims to be used on the bevel pinion varies from one machine to another on account of a number of factors involved in machining and assembling. Thus, for each machine, the amount of shims necessary for locating the pinion in the correct position (for producing a proper backlash in the mesh between pinion and gear) must be determined anew at the time of reassembly.

In order to facilitate this determination, a two-piece dummy tool (special tool) is made available. The following procedure is based on the use of this tool and supposes that the pinion dummy (one of the two pieces) is set in the carrier, without any shims, as shown in Fig. 15-9.

Bevel pinion mounting dummy Ⓐ

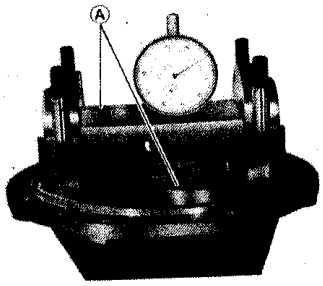


Fig. 15-9

●Set the dial indicator on the dummy, letting the indicator spindle protrude 5 to 6 mm from the bottom of the dummy as shown in Fig. 15-10-1

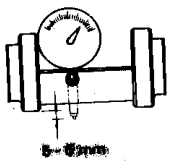


Fig. 15-10-1

●Rest the dummy on the surface plate, and set the dial indicator to zero. See Fig. 15-10-2.

●Feed the dummy pinion into the carrier, positioning it properly; and install the joint flange. Secure the joint flange in place by tightening its nut to 70 kg-cm (5. 0 lb-ft) torque.

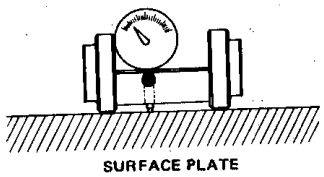
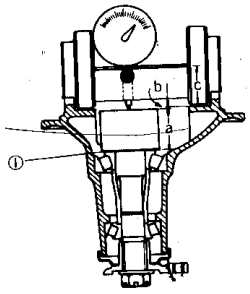


Fig. 15-10-2

●Referring to Fig. 15-10-3, note that three dimensions are involved; "a" "b" and "c". The value of "b" is unknown, and is to be determined now for calculating the required thickness of shims. The value of "a" + "c" is 80mm (3. 15in.).



① Clearance

Fig. 15-10-3

With the dummy now secured, the dial indicator hand may have deflected from the "0" mark to

show a certain value; read this value, which is the value of "b". Add this reading to 80mm (= "a" + "c") and, from the sum, subtract the value marked on the bevel pinion. The remainder is the required shim thickness:

(80 + "b") - marked value = required shim thickness

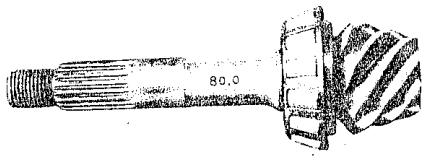


Fig. 15-11

- The shim stock is available in five selective thicknesses. Select and combine shim sizes to produce a total thickness as close to the required thickness as possible, and insert the selected shim pieces into the clearance ① indicated in Fig. 15-10-3.

Sizes of shims for bevel pinion.	0.03, 0.05, 0.1, 0.3 &0.5mm (0.0012, 0.002, 0.004, 0.012&0.02in.)

Bevel pinion bearing preload adjustment

The bevel pinion, as installed in the normal manner in the carrier, is required to offer a certain torque resistance when checked with the use of a prescribed torquing pulley (special tool Ⓐ) as shown in Fig. 15-12. This resistance is a "preload", which is due to the tightness of the two tapered roller bearings by which the pinion is held in the carrier. And this tightness is determined primarily by the thickness of the adjusting collar, plus a shim.

Check the preload and, if the preload measurement is off the specified range indicated below, increase or decrease the thickness of the shim. The method is as follows:

Tentatively install the pinion in the carrier, using the adjusting collar and a 1 mm thick shim, and tighten the nut to secure the splined yoke. The nut is to be tightened to the specified torque:

Tightening torque on bevel pinion nut	107.8~166.6N · M

Put on the torquing pulley (special tool) and give a pull, as shown in Fig. 15-12, and read the spring balance indication just when the pulley begins to turn. The reading is a starting torque, and is required to be within the 0.6 to 1.4kg range (equivalent to the specified torque range of 3.0 to 7.0 kg-cm).

Pinion bearing preload	3.0~7.0kg-cm (2.6~6.1lb-in.)
Starting torque (with pulley)	0.6~1.4kg (1.32~3.06lb)

Increasing the shim thickness decreases this preload, and vice versa. Five-size shim stock available for "mounting distance" adjustment, mentioned above, is meant to be used in producing a proper shim thickness in this preload adjustment too.

Preload-check torquing pulley (A)

NOTES:

- **When tentatively installing the pinion in the carrier, be sure to oil the bearings lightly with gear oil, and to leave out the oil seal.**
- **Make a note of the starting torque.**

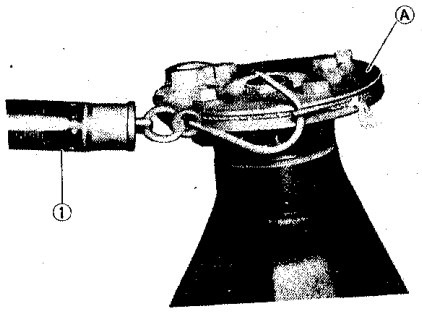


Fig. 15-12 ①Spring measure

Bevel gear backlash adjustment

The backlash between bevel gear and pinion is to be checked in the manner shown in Fig. 15-13. Note that the differential case assembly is mounted in the normal manner, and fastened down by tightening the side bearing cap bolts to the specification torque value. The dial indicator spindle is pointed squarely to the "heel" on the drive side (convex side) of a gear tooth. Hold the bevel pinion rigidly, and turn the gear back and forth.

The dial indicator reading, which is a backlash value, is required to be within this range:

Bevel gear backlash	0.10～0.20mm

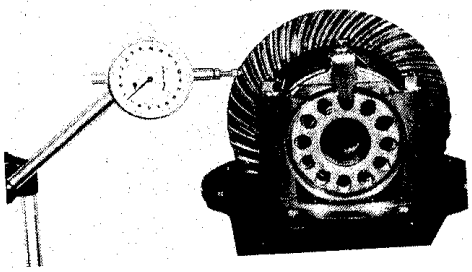


Fig. 15-13

To increase or decrease the backlash for adjustment, displace the bevel gear toward or away from the pinion by running in one adjuster and running out the other adjuster by an equal amount (with the side bearing cap bolts slightly loosened).

Turning the adjuster one notch changes the backlash by about 0.1mm (0.004in.)

Side bearing adjuster turner Ⓐ

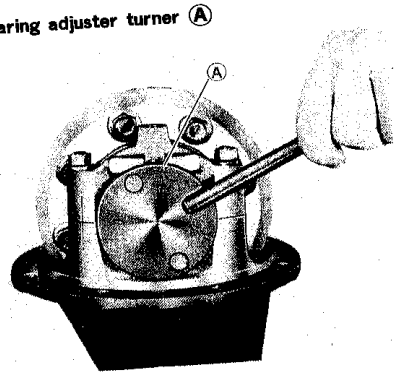
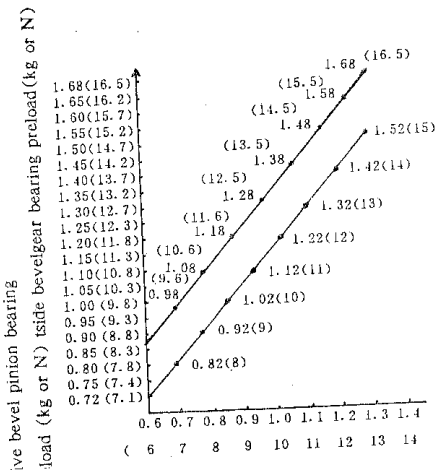


Fig. 15-13-1

CAUTION:

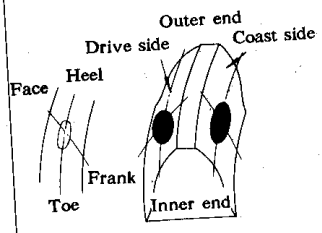
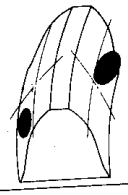
Adjust the preload on the side bearing during backlash adjustment; mount the preload check torquing pulley Ⓐ on the drive bevel pinion as shown in Fig. 15-12 and measure using spring measure ①. When the reading at the instant the side bevel gear starts moving is within the range as indicated below, the side bearing preload is acceptable. Referring to the graph, for example, when the drive bevel pinion bearing preload measured as indicated in Fig. 15-12 is 1.0kg(9.8N), drive bevel pinion bearing preload + side bevel gear bearing preload should be 1.12～1.28 kg(11～13N)


ive bevel pinion bearing
load (kg or N) tside bevelgear bearing preload(kg or N)
1.68(16.5)
1.65(16.2)
1.60(15.7)
1.55(15.2)
1.50(14.7)
1.45(14.2)
1.40(13.7)
1.35(13.2)
1.30(12.7)
1.25(12.3)
1.20(11.8)
1.15(11.3)
1.10(10.8)
1.05(10.3)
1.00 (9.8)
0.95 (9.3)
0.90 (8.8)
0.85 (8.3)
0.80 (7.8)
0.75 (7.4)
0.72 (7.1)
(16.5)
(15.5)
(14.5)
(13.5)
(12.5)
(11.6)
(10.6)
(9.6)
1.68
1.58
1.48
1.38
1.28
1.18
1.08
0.98
1.52(15)
1.42(14)
1.32(13)
1.22(12)
1.12(11)
1.02(10)
0.92(9)
0.82(8)
0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4
(6 7 8 9 10 11 12 13 14

Pinion-to-gear tooth contact pattern check and adjustment

In addition to proper backlash, proper tooth contact must be secured in the mesh of bevel pinion and gear, so that there will be no "gear noise" coming from the axle and that the hypoid teeth will not be overstressed in transmitting drive.

After the specified amount of backlash has been secured, check the pinion and gear for tooth contact by "rolling" contact patterns in a manner consistent with the standard shop practice: use a red lead paste to paint ten teeth, both drive side and coast side, of the gear, turn the gear back and forth by hand while holding the pinion in a "braking" manner, and examine the contact patterns in reference to the following chart:

	Contact patterns	Diagnoisis, and what to do
Normal contact pattern		Contact is roughly centered and somewhat more displaces toward toe than toward heel on both drive side(concave)and coast(convex)side.
Patterns due to improper shim adjustment		High contact: Contact is on heel(drive side)and on toe(coast side). This condition means that the pinion is too far back and must be brought forward by increasing its shim thickness used in "mounting distance" adjustment.
		Low contact: Contact is on toe(drive side)and on heel on (coast side). This condition means that the pinion is too far out from the carrier and must be backed away by decreasing its shim thickness.

CAUTION:
When applying the red lead paste to the teeth, be sure to paint the tooth surfaces uniformly. The paste must not be too dry or too fluid.

15-5. Reassembly Instructions

Tightening torque

	kg-m (N · M)
Side bearing cap nut	2.0～2.5(19.6～245)
Drive bevel gear bolt	6.5～8.0(63.7～78.4)
Drive bevel pinion nut	11.0～17.0(107.8～166.6)
Differential carrier nut	1.5～2.3(14.7～22.5)
Oil drain plug	4.0～7.0(39.2～68.6)

Drive bevel gear bolts

The bolts securing the bevel gear to the differential case are subject to shear stress since drive is transmitted by these bolts from the gear to the case. For this reason, they are special bolts made from chrome steel and must never be replaced by common bolts.

When mounting the gear on the case, be sure to apply the thread lock Anaerobic cement GY-260 to these bolts before running them in.

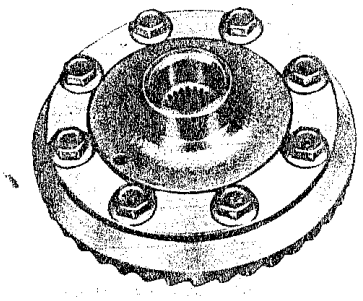


Fig. 15-14

Bevel pinion bearings

A press must be used to install the two tapered roller bearings on the bevel pinion. Outer races are to be press-fitted into the differential carrier and the inner races onto the pinion.

(1) For the outer race of front bearing (yoke side), the special tool indicated here, must be used:

Bearing installer Ⓐ

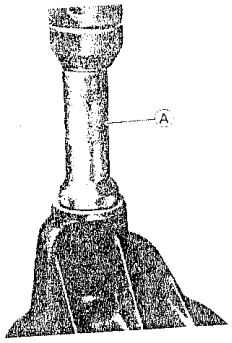


Fig. 15-15

(2) For the outer race of rear bearing (gear side):

Bearing installer Ⓑ

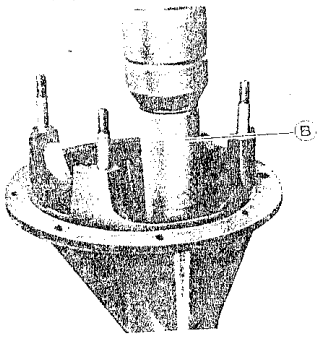


Fig. 15-16

(3) For the inner races, use this special tool:

Bearing installer Ⓐ

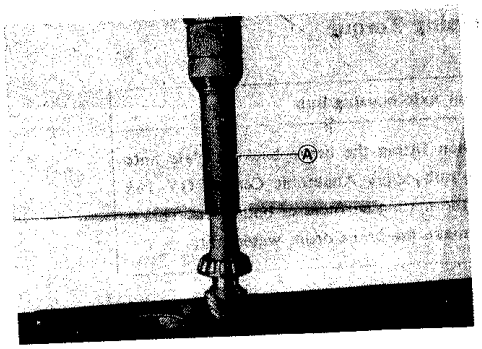
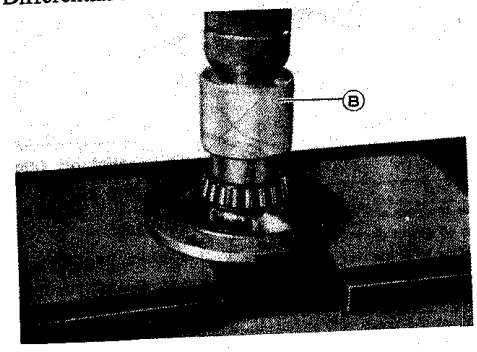


Fig. 15-17

Differential side bearings

Press-fit these bearings into the differential case by using the special tool. Driving the bearing into the case is not permitted.

Differential side bearing installer Ⓑ



Differential gear oil

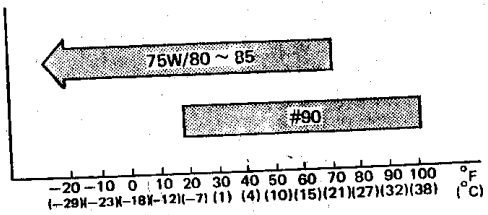
About 1. 0 litre of gear oil is required to fill up the differential housing.

Differential gear oil specification

Oil capacity	1. 0 litre(2. 1-1. 8US/Imp pt)
Gear oil	Hypoid gear oil, 90ZBE36006-87 SAE#90

GEAR OIL

Recommended SAE viscosity number



NOTE:
For the vehicles used in the areas where the ambient temperature becomes lower than -15°C (5°F) during the coldest season, it is recommended that oil be changed with SAE 80W or 75W/80~85 oil during the services such as a periodic maintenance.

15-6. Important Steps in Installation and Tightening Torque

Hub bolt

When mounting the hub bolts into the rear axle shaft, make sure to fit the head securely in the stepped part of the axle shaft.

Rear axle housing hub

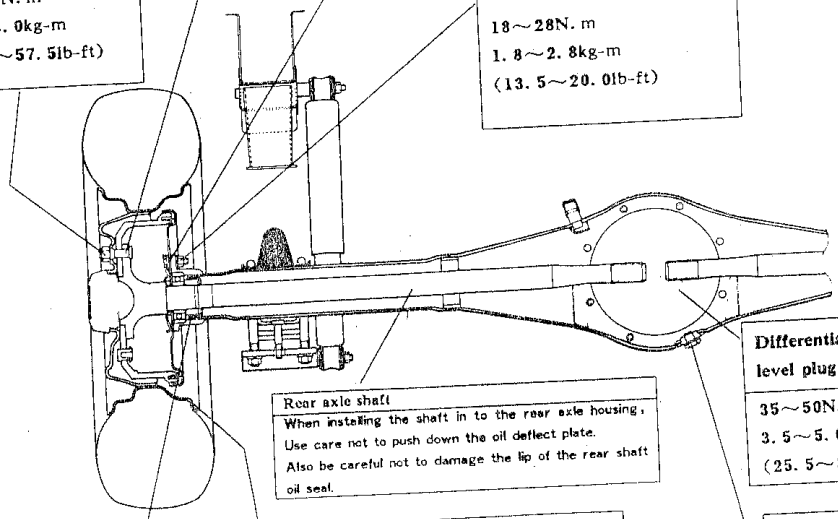
When fitting the brake backing plate onto the hub, apply Anaerobic Cement GY-168 to the mating surfaces of both parts. This is to make the brake drum watertight.

Wheel nuts

60～80N. m
6. 0～8. 0kg-m
(43. 5～57. 5lb-ft)

Brake backing plate nuts

18～28N. m
1. 8～2. 8kg-m
(13. 5～20. 0lb-ft)



Rear axle shaft

When installing the shaft in to the rear axle housing, Use care not to push down the oil deflect plate. Also be careful not to damage the lip of the rear shaft oil seal.

Differential oil filler and level plug

35～50N. m
3. 5～5. 0kg-m
(25. 5～36. 0lb-ft)

Wheel

When installing the wheel onto the brake drum, bring the air valve close to the brake skoe adjusting hole of the drum.

Differential oil drain plug

40～70N. m
4. 0～7. 0kg-m
(29. 0～50. 5lb-ft)

Oil seal

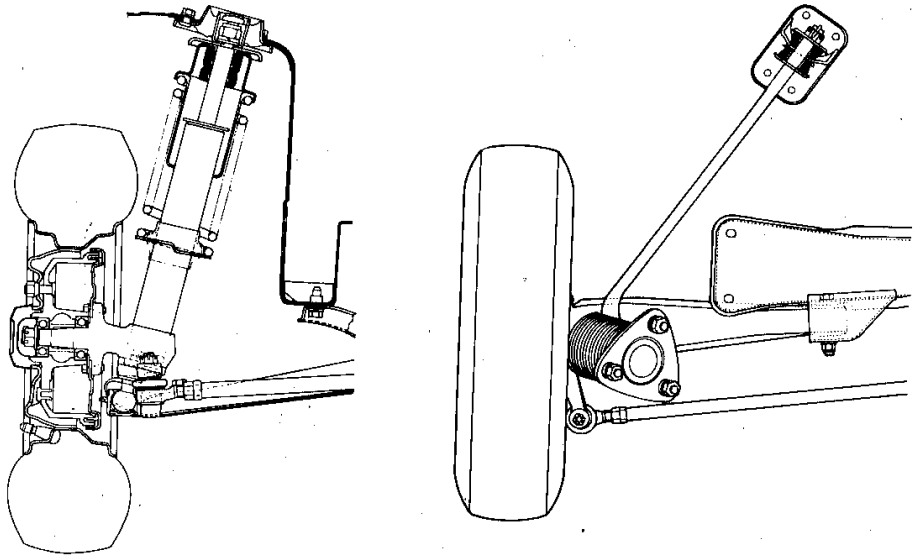
Install the oil seal so that the side with spring "A" faces the differential side. Also, before its installation, be sure to apply Calcium base grease or ZG-2(GB491-65)to its lip "B".

16. SUSPENSION

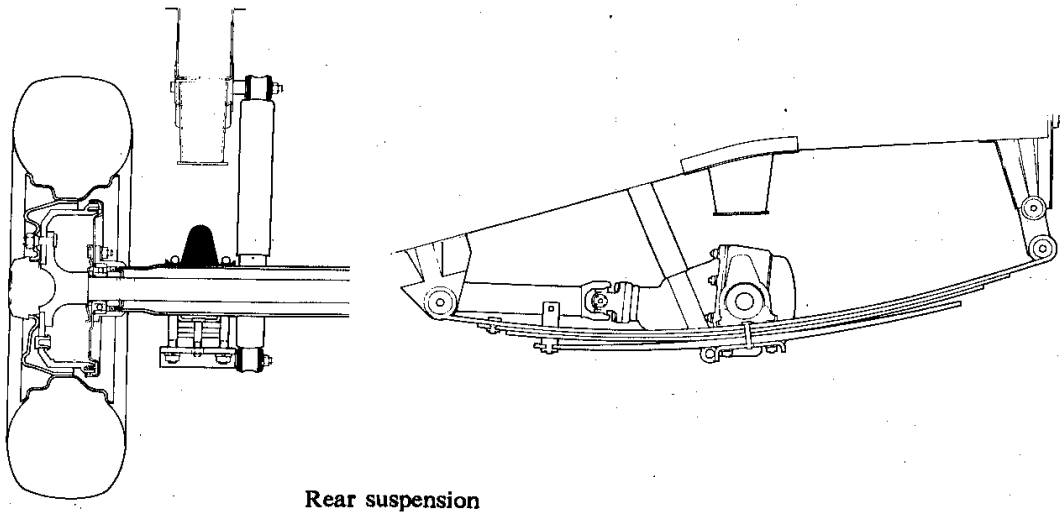
16-1. Description

Front suspension is Macpherson (suspesion strut) type as shown in the Fig. 16-1, and consists of coil springs, front suspension struts, knuckle arms, and front suspension arms. In this type of construction, shock applied to wheels is distributed through knuckle arms from front suspension struts, coil springs, to front suspension arms, and are absorbed.

The rear suspension uses semi-elliptic leaf springs mounted on the rigid axle, and the leaf spring is supported by rubber bushing at both ends. The use of single-action absorber gives a greater damping effect, thus providing superb riding comfort even on rough roads.



Front suspension



Rear suspension

Fig. 16-1

16-2. Front Suspension Strut

Since the front suspension strut services as both the oil damper and steering king pin, this unit should be checked in respect of these two functions. Following shows the check items.

- Check for the roadability of the vehicle and rattling sound while driving on rough roads.
- Push the body hard , and if it jolts 3-4 times the damping force of the shock absorber is considered to have decreased.
- Check the absorber for oil leakage. If the absorber is found faulty, replace it as a assembling unit, because it can not be disassembled.

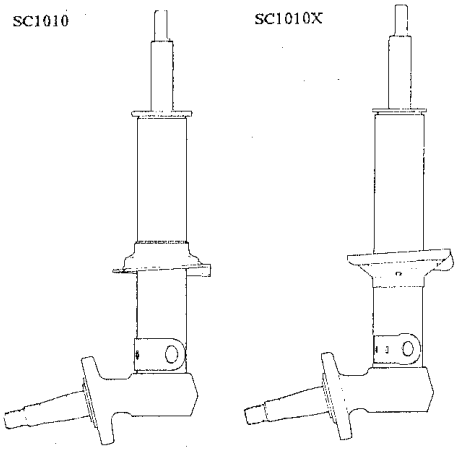


Fig. 16-2

Front coil spring

Compress coil spring using special tool, front coil spring tool Ⓐ until play between coil spring and spring seat is obtained. Remove lock nut of front suspension strut, and then remove strut support complete, bearing and coil spring. Front coil spring itself is almost trouble free, but when it is found weak after a long time of use, it should be replaced.

	Standard	Limit
Coil spring free length	268mm (10.55in.)	255mm (10.04in.)

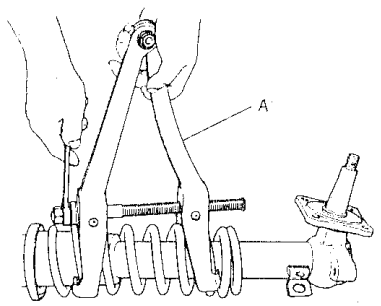


Fig. 16-3

16-3. Ball Joint

The ball joint is constructed as shown in the Fig. 16-4 and as already noted, it does not allow disassembly. Check it for wear and noise by moving the ball joint stud, and check it for cracking of the caulked area. When it is found faulty, replace it. Make sure that the ball stud end will begin to move with a torque of 10-40 kg-cm(0.73～2.90lb-ft).

NOTE;
Fit nut on the ball stud screw and measure the turning torque of the ball stud with a torque wrench.

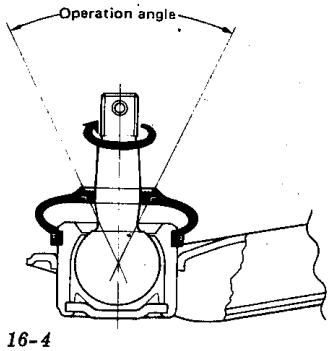
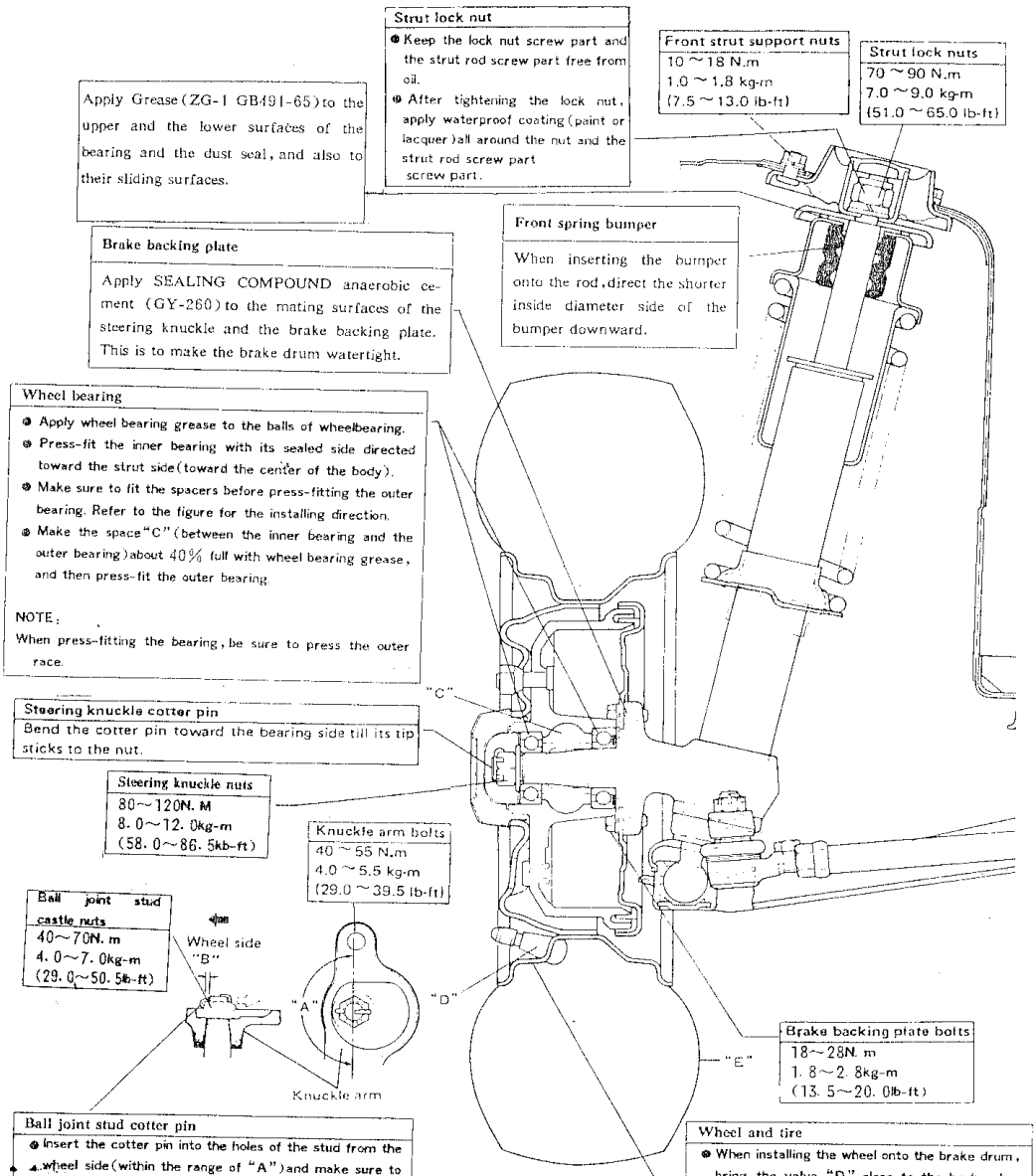
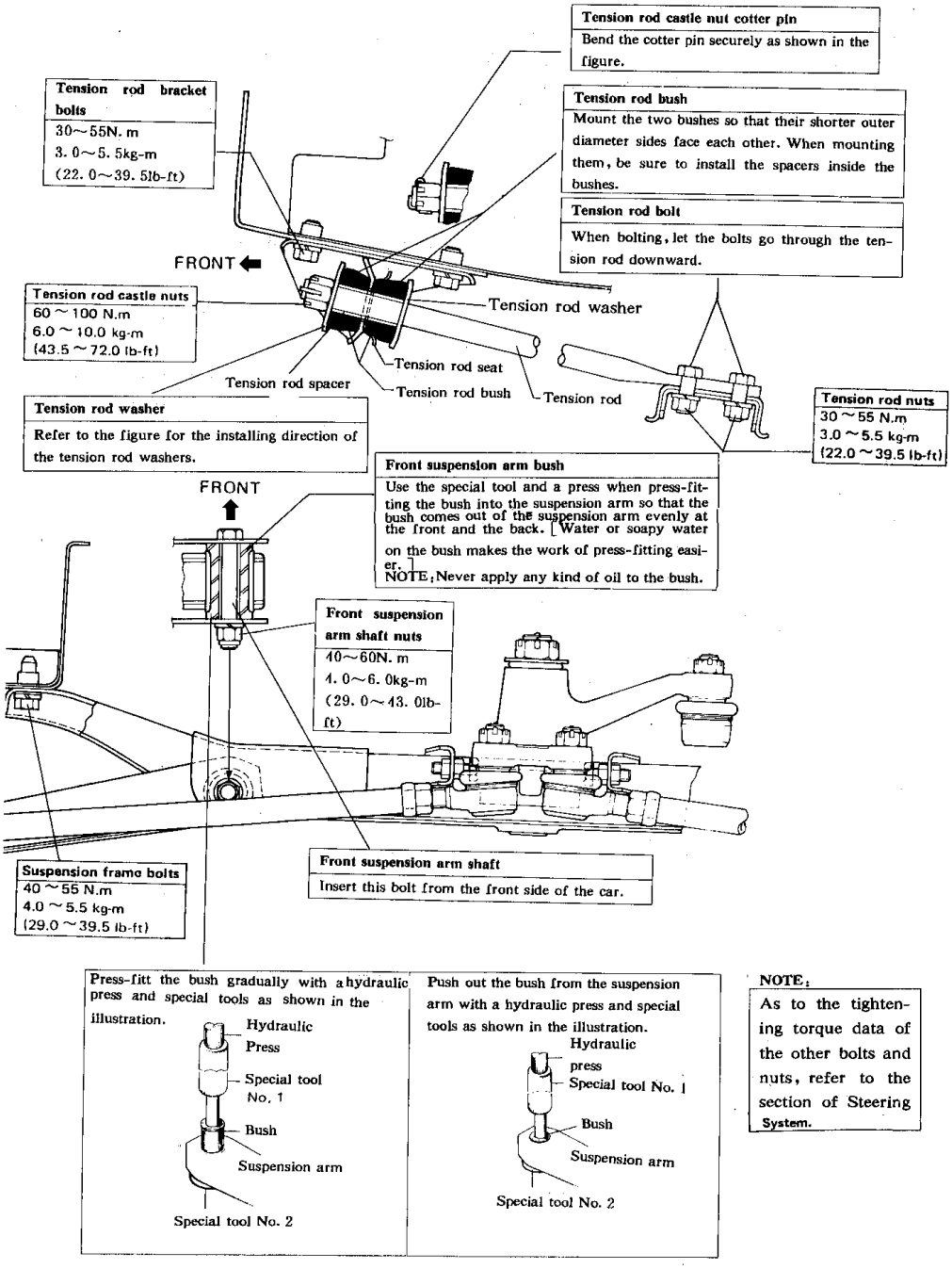


Fig. 16-4

16-4. Important Steps in Installation and Tightening Torque (Front suspension)




Tension rod castle nut cotter pin
Bend the cotter pin securely as shown in the figure.
Tension rod bracket bolts
30~55N. m
3. 0~5. 5kg-m
(22. 0~39. 5lb-ft)
Tension rod bush
Mount the two bushes so that their shorter outer diameter sides face each other. When mounting them, be sure to install the spacers inside the bushes.
Tension rod bolt
When bolting, let the bolts go through the tension rod downward.
FRONT
Tension rod castle nuts
60 ~ 100 N.m
6.0 ~ 10.0 kg-m
(43.5 ~ 72.0 lb-ft)
Tension rod washer
Tension rod seat
Tension rod spacer
Tension rod bush
Tension rod
Tension rod nuts
30 ~ 55 N.m
3.0 ~ 5.5 kg-m
(22.0 ~ 39.5 lb-ft)
Tension rod washer
Refer to the figure for the installing direction of the tension rod washers.
FRONT
Front suspension arm bush
Use the special tool and a press when press-fitting the bush into the suspension arm so that the bush comes out of the suspension arm evenly at the front and the back. [Water or soapy water on the bush makes the work of press-fitting easier.]
NOTE; Never apply any kind of oil to the bush.
Front suspension arm shaft nuts
40~60N. m
4. 0~6. 0kg-m
(29. 0~43. 0lb-ft)
Suspension frame bolts
40 ~ 55 N.m
4.0 ~ 5.5 kg-m
(29.0 ~ 39.5 lb-ft)
Front suspension arm shaft
Insert this bolt from the front side of the car.
Press-fitt the bush gradually with a hydraulic press and special tools as shown in the illustration.
Hydraulic Press
Special tool No. 1
Bush
Suspension arm
Special tool No. 2
Push out the bush from the suspension arm with a hydraulic press and special tools as shown in the illustration.
Hydraulic press
Special tool No. 1
Bush
Suspension arm
Special tool No. 2
NOTE;
As to the tightening torque data of the other bolts and nuts, refer to the section of Steering System.

● Left-hand and right-hand front suspension struts differ in location of brake hose bracket attached to the strut. In correct installation, brake hose bracket is toward the center of the body as shown in the Fig. 16-7.

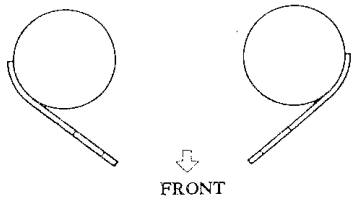


Fig. 16-7

16-5. Leaf Spring

Inspection

If the chassis is found lower than the normal position owing to the excessive fatigue of the leaf spring, check the height of the spring from the center bolt. If the fatigue of the spring is excessive, replace the spring.

Free height (H)	113mm(4. 45in.)

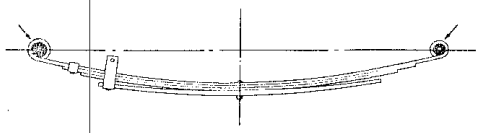


Fig. 16-8

16-6. Shock Absorber

Inspection

The absorbers are of double-acting type. By trying to contract and extend each absorber by hand, the effectiveness of its damping action can be told. Absorbers found with oil leck or with inadequate damping effectiveness must be replaced.

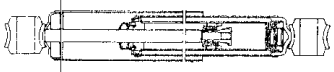
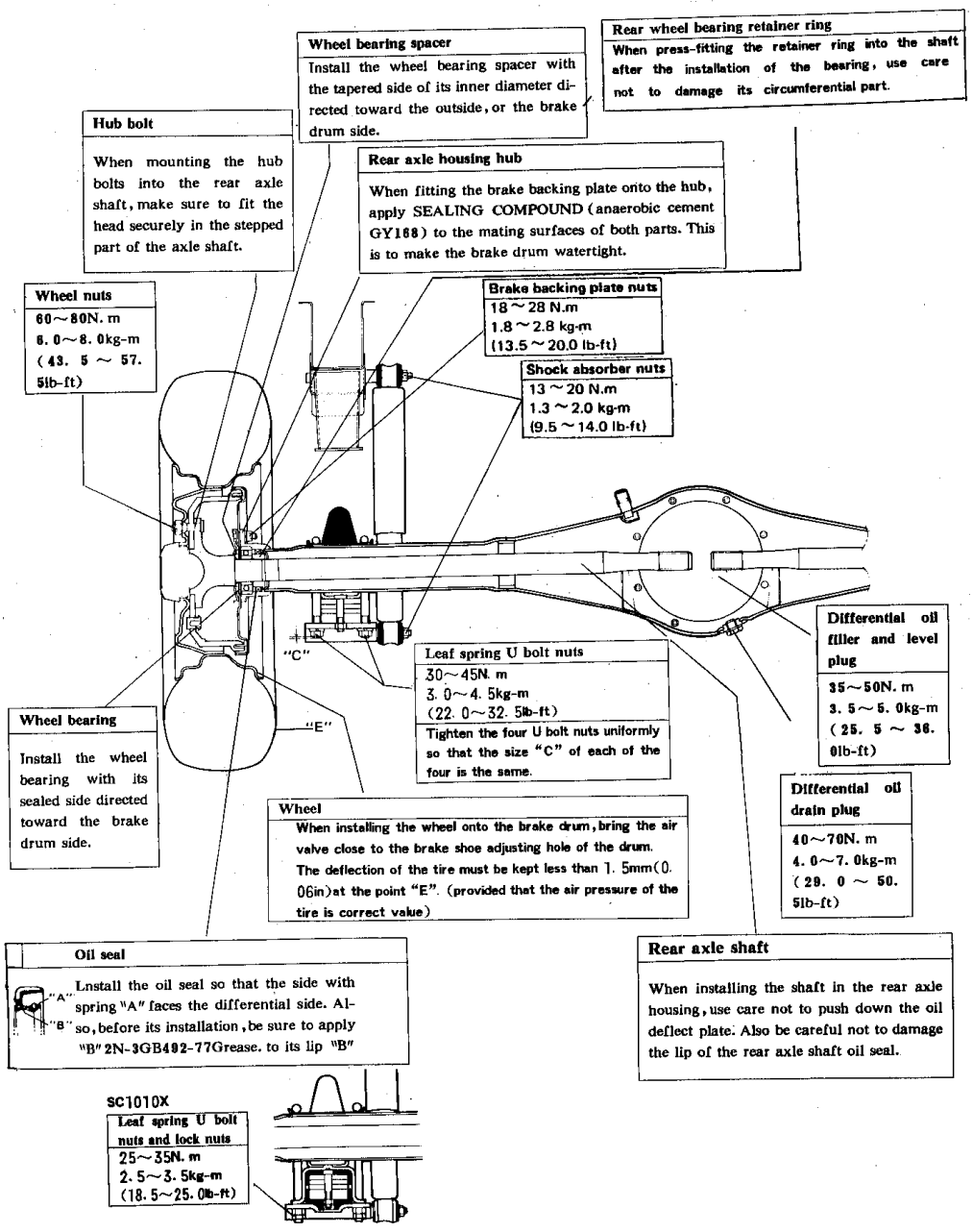
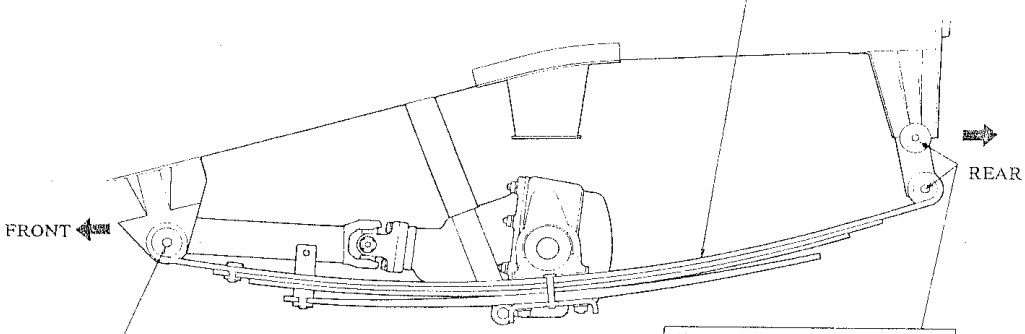


Fig. 16-9

16-7. Important Steps in Installation and Tightening Torque(Rear suspension).





Leaf spring

When installing the leaf spring, be sure that No. 1, No. 2, No. 3 and No. 4 leaves do not get out of their positions.

Leaf spring nuts

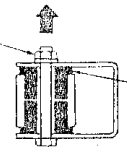
45～70N. m 4. 5～7. 0kg-m (33. 0～ 50. 5lb-ft)	●Mount the leaf spring bolts at the both ends from the outside of the car toward the inside. ●Tighten the leaf spring nut in unladen state.

Shackle pin bushes

Press-fit the shackle pin bushes. Some water or soapy water applied to the bushes will make the work easier.
Note; Never apply any kind of oil to the bushes.

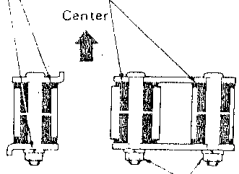
Shackle plates

Refer to the figure for the installing direction of the shackle plates.



Leaf spring front bush

The method of fitting the leaf spring front bushes is the same as that of fitting the shackle pin bush.



Shackle pin nuts

30～55N. m 3. 0～5. 5kg-m (22. 0～ 39. 5lb-ft)	●Install the shackle pins, both right and left, from the center of the car toward the outside. ●Tighten the shackle pin nuts in unladen state.

17. STEERING SYSTEM

17-1. Description

The rotary motion of the steering handwheel is changed to the linear motion of the drag link through the steering gearbox and pitman arm. The drag link pulls and pushes the steering center lever, so that this lever turns the right and left front wheels around their kingpins through the two tie rods and knuckle arm.

The whole system has a self-restoring property, and is designed for easy steering and high durability. The self-restoring action is reliable; the operating effort required for turning the handwheel is small; and the system components are easy to service. The rotary joints of the steering linkage are of ball-and-socket type.

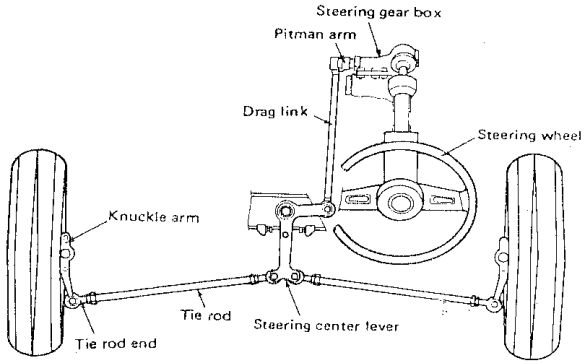


Fig. 17-1

17-2. Specifications and Data

Steering gear box	Recirculating ball-and-nut type
Gear ratio	15.4(0～4°)～17.4(over 26.5°)
Steering angle, inside	33°
Steering angle, outside	27°
Steering wheel diameter	384mm(15.11in.)
Minimum turning radius	4.1m(13.45ft.)

17-3. Steering Gear Box Construction and Operation

The pitman arm is rigidly connected to the outer end of the shaft integral with the sector gear, which is inside the gear box and meshed with the teeth of the nut capable of sliding along the worm. Between the

nut and the worm is a row of steel balls(actually a total of 52 balls are used), which serves two purposes, to provide rolling contact between nut and worm and to keep the nut engaged with the worm as if the two were threadedly engaged. With the nut prevented from turning, the rotation of thd worm causes the nut to move up or down the worm.

The worm is an extension of the steering shaft. As the handwheel is turned, the steel balls roll along in the groove and the nut moves up or down. The steel ball that has reached the end of the groove in the nut enters the return guide. The guide sends the ball back to the other end of the same groove. In this way, the row of balls recirculated.

By so moving, the nut turns the sector gear and hence the pitman arm. It should be noted here that it is through the steel balls that a rotary motion of the worm is converted into a linear motion of the nut, which is then converted into another rotary motion of the sector gear.

The steering gear box is a precision-machined device, each part of it being machined to a closer tolerance for smooth conversion of motion, and is built sturdy for long service life. Special tools and instruments are needed in addition to specialized skill if the gear box is to be overhauled. For this reason, a gear box found to be in defective condition should be replace by a new one; replacement is more economical and, what is perhaps more important, safer.

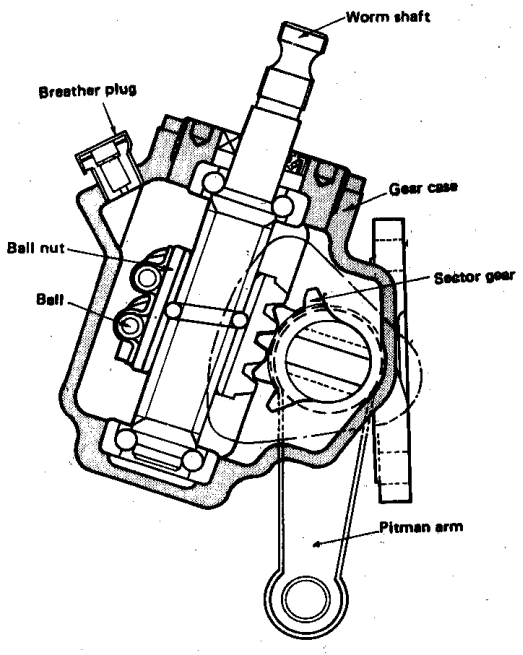


Fig. 17-2

17-4. Removal

1)Steering shafts

Loosen the bolts on the rubber joint flange at the bottom end of the steering upper shaft.

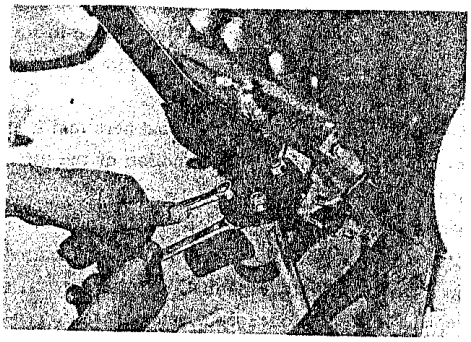


Fig. 17-4

Disconnect the wiring harness, and remove the four bolts fastening the steering column to the column bracket. Pull up the steering upper shaft.

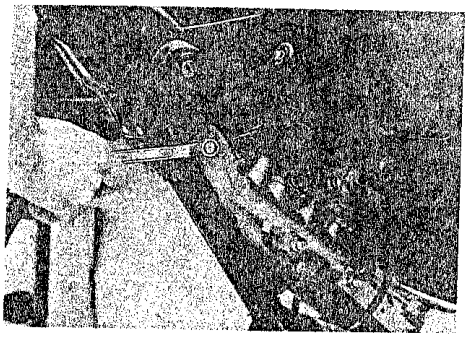


Fig. 17-5

Loosen the bolt on the steering lower shaft joint and remove the steering lower shaft.

2)Gear box

Disconnect drag link from pitman arm. If the link will not come off easily, give two or three light hammer blows to the face ① of pitman arm and tap on the stud lightly to shake the connection loose. This will help the link ball stud slide off the arm.

CAUTION:

Where the gear box has been removed, be sure to position it is such a way that the breather plug (Fig. 17-2) will point up at the time of re-installing the box. Gear oil might leak out through the breather if it is not pointing up.

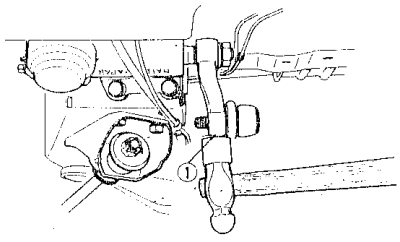


Fig. 17-6

The steering gear box is secured in place by three mounting bolts. Remove these bolts and take down the gear box.

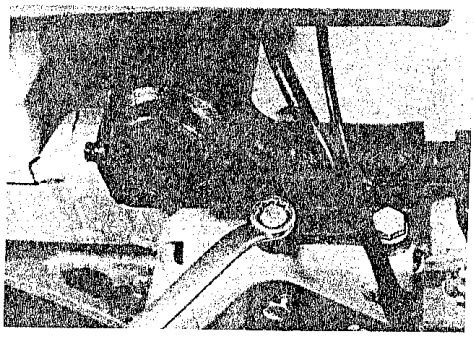


Fig. 17-7

17-5. Maintenance Services

Steering handwheel play

The wheel play is proper if it is anywhere between 10 and 30mm (0. 4and 1. 2in.) as measured at the rim. An unusually large play means that the wear in the steering gear box is excessively large.

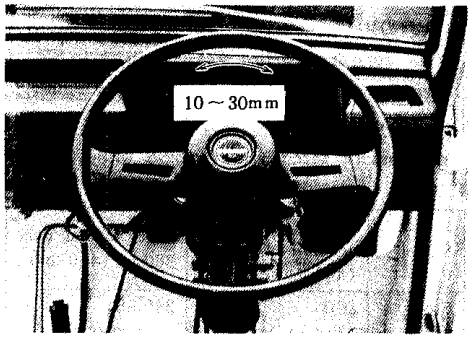


Fig. 17-8

Steering gear box

1)If any evidence of oil leakage is noted on the gear box upon inspection of the machine brought in for servicing, remove the plug(Fig. 17-9)and check the level of oil inside. The oil surface should be up to about 12mm (0. 48in.) below plug; if not, add oil. Be sure to use the prescribed gear oil, SAE # 90, hypoid gear oil 90ZBE 36006—87.

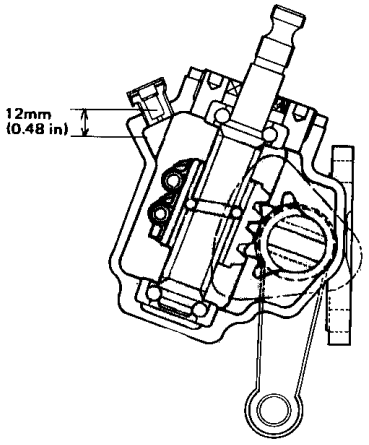


Fig. 17-9

2)The adjusting bolt on the steering gear box is for giving a preload to the worm shaft. If this shaft is noted to have any rattle, check its starting torque by using a spring balance, and tighten adjusting bolt①, Fig. 17-10, to obtain the specified torque.

CAUTION;

• When making this adjustment, be sure that the steering gear box is in the position for straightahead rolling; gear teeth in the gear box might break off as the adjusting bolt is tightened, if the gear box is off this center position.

• Have the drag link and steering shaft disconnected from the gear box. The starting torque specification refers to the gear box as an individual component.

Starting-torque of worm shaft	2. 0-5. 0 kg. cm (0. 145-0. 362 lb-ft)

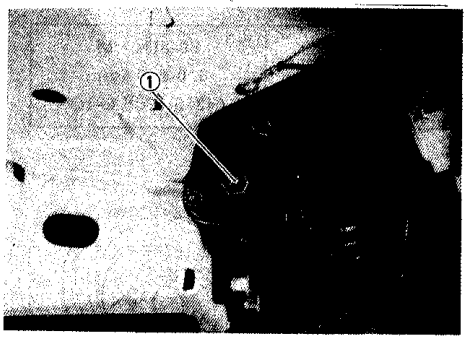


Fig. 17-10

Steering rubber joint

Inspect the rubber joint for evidence of crack or breakage, and make sure that its bolts are tight.

Fig. 17-11

Wheel and wheel nuts

Inspect each wheel disc for cracks, dents and distortion. A disc in badly damaged condition must be replaced. Check the wheel nuts for tightness and, as necessary, retighten them to the specification.

Tightening torque for wheel nuts	60-80N · M 6. 0-8. 0 kg-m (43. 5-57. 5 lb-ft)

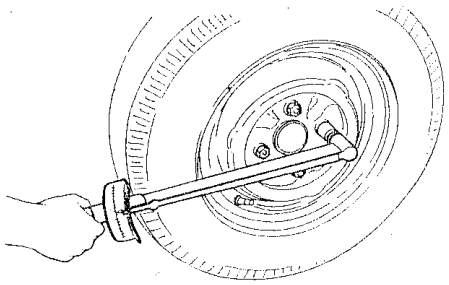


Fig. 17-12

Tires

A tire badly worn, torn or otherwise deteriorated must be replaced. Check the inflating pressure of each tire and, as necessary, adjust the pressure to the specification.

Properly inflated tires are one of the keys to satisfactory cruising performance. Be sure to advise the user about the importance of keeping the tires inflated to the pressures specified.

CAUTION:
After adjusting the tire pressure, check to be sure that the air valve is free from any signs of leakage.

Tire pressure specification (vehicle with4. 50-12-8PR)

Wheel	When loading under 200 kg (440 lbs)	When loading over 200 kg (440 lbs)
Front wheel tires	200 (1. 8 kg/cm², 29 psi)	240 kPa (2. 4 kg/cm², 35 psi)
Rear wheel tires	200 kPa (1. 8 kg/cm², 29psi)	375 kPa (3. 7kg/cm², 54 psi)

Tire pressure specification (vehicle with 145R12-6PR)

Wheel	When loading under 200 kg (440 lbs)	When loading over 200 kg(440 lbs)
Front wheel tires	160 kPa (1. 6 kg/cm², 23 psi)	180kpa (1. 8 kg/cm², 26 psi)
Rear wheel tires	160 kPa (1. 6 kg/cm², 23 psi)	280 kPa (2. 8 kg/cm², 40 psi)

CAUTION:
Check the inflation pressure from time to time while inflating the tire gradually till the specified pressure is obtained.

Check the wear indicator shown in Fig. 17-13; and replace the tire when its wear is the same level as the indicator.

Tire service limit	Less than 1. 6mm (0. 063in.) depth of tread at two places.

4. 50-12-8PR Tires

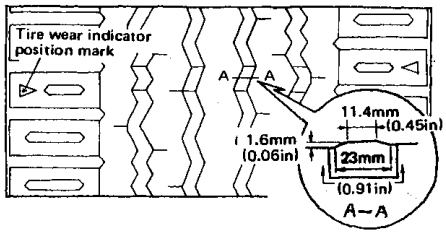


Fig. 17-13

"Rotate"the tires at the regular intervals, stated below, in order to equalize tire wear and thereby make full use of each tire. Refer to Fig. 17-13-1 for the scheme of rotation. Adherence to this scheme prolongs tire life.

Tire rotation interval	Every10,000km (6,215miles)

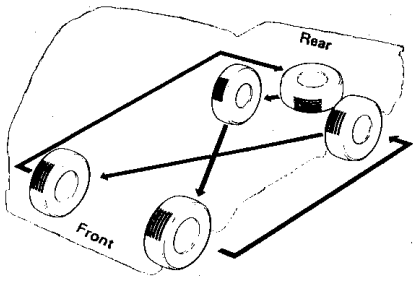


Fig. 17-13-1

17-6. Important Step in Reassembly

Steering center lever

This lever is required to take a certain position when the front wheels are pointed straightahead. Specifically, the axis of the long arm of this lever (jointed to the tie rod) must be parallel to the longitudinal center line of the machine. When installing the steering linkage, make sure that this requirement is satisfied within the allowable error of one degree.

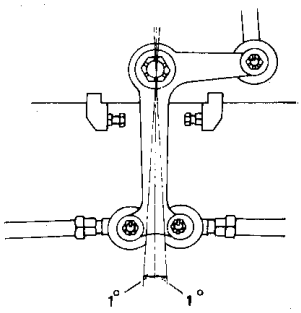


Fig. 17-14

17-7. Important Steps in Installation and Tightening Torque

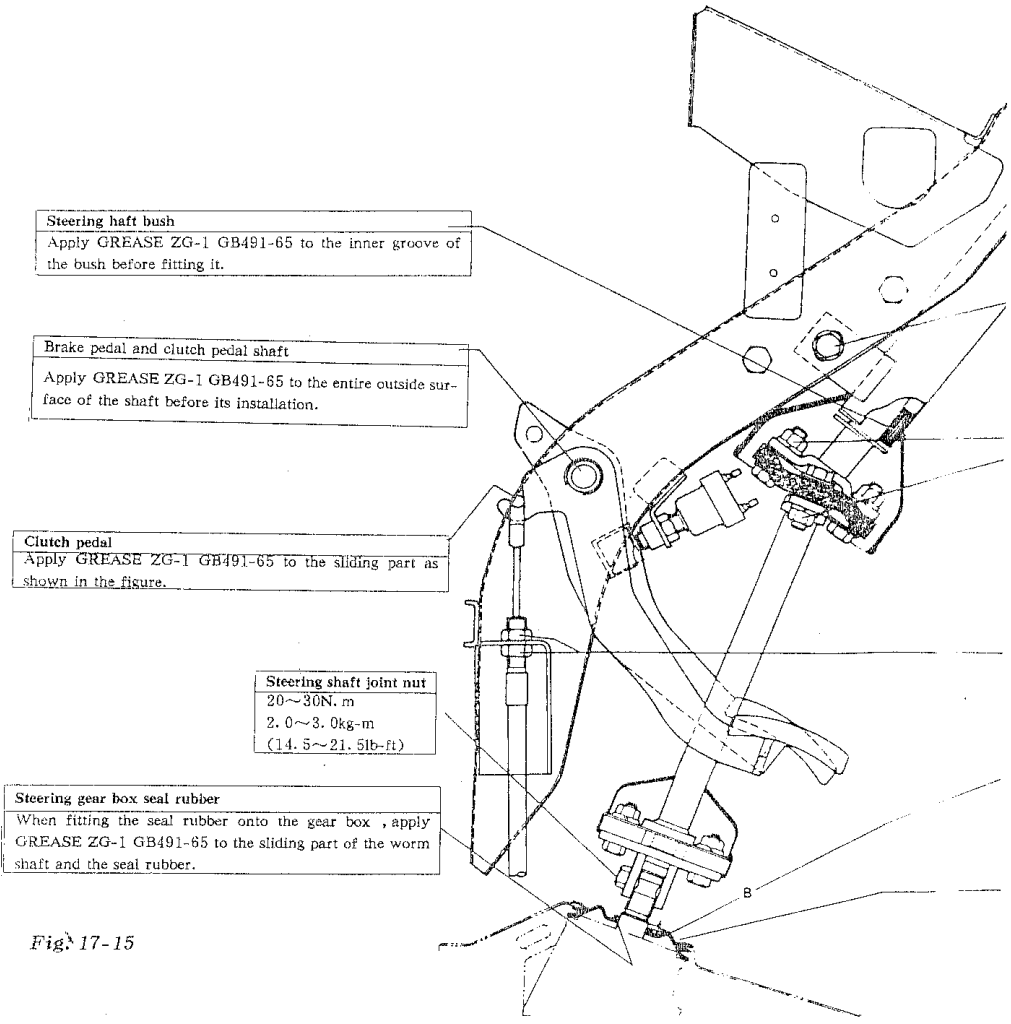
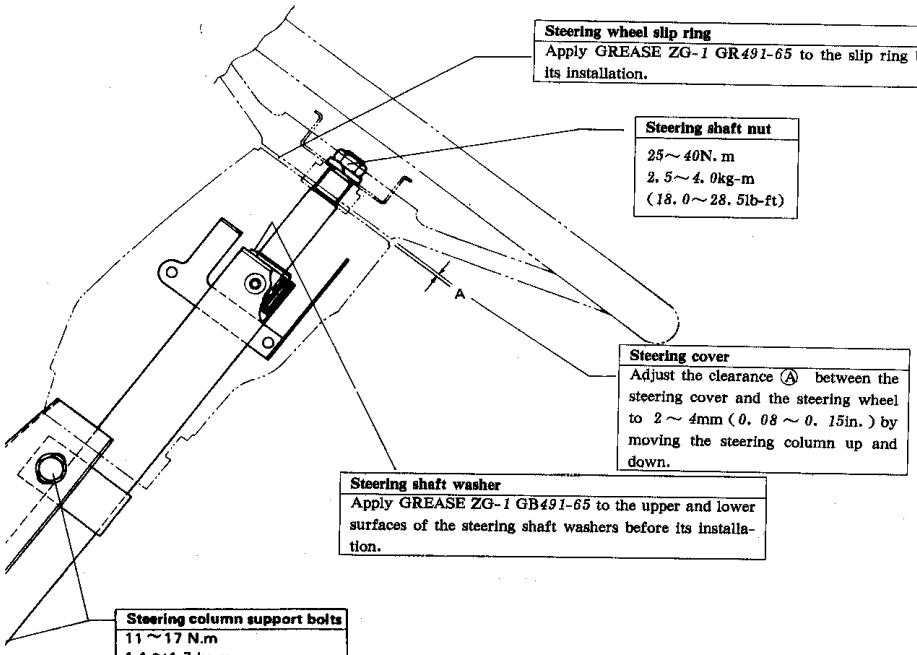


Fig. 17-15



Steering wheel slip ring

Apply GREASE ZG-*1* GR*491-65* to the slip ring before its installation.

Steering shaft nut

25～*40*N. m
2. 5～*4. 0*kg-m
(*18. 0*～*28. 5*lb-ft)

Steering cover

Adjust the clearance Ⓐ between the steering cover and the steering wheel to *2*～*4*mm (*0. 08*～*0. 15*in.) by moving the steering column up and down.

Steering shaft washer

Apply GREASE ZG-*1* GB*491-65* to the upper and lower surfaces of the steering shaft washers before its installation.

Steering column support bolts

11～17 N.m
1.1～1.7 kg-m
(8.0～12.0 lb-ft)

Steering rubber joint nuts

15～*25*N. m
1. 5～*2. 5*kg-m
(*11. 0*～*18. 0*lb-ft)

Clutch cable nut

Tighten the upper and the lower nuts firmly with two spanners. Refer to Group *11* for the adjustment of the clutch pedal.

Steering gear box seal rubber

After fitting the seal rubber onto the floor and the gear box, push it in downward so that it does not contact the serration of the gear box and the length (width) "B" exceeds 2mm(*0. 08*in.).

Steering gear box seal rubber

When fitting the seal rubber onto the floor, apply adhesive to the entire contact surfaces of both parts.

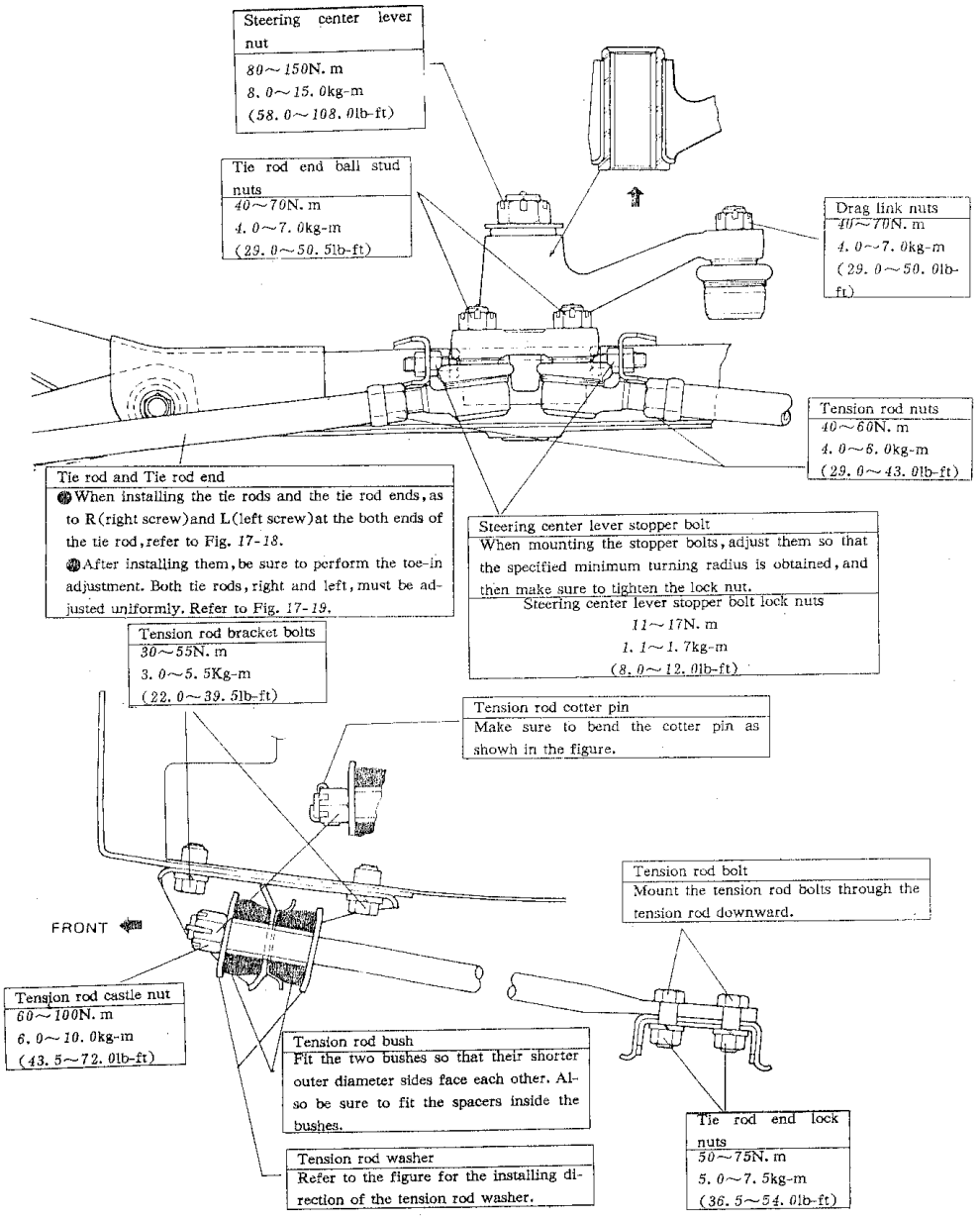

Steering center lever nut
80～150N. m
8. 0～15. 0kg-m
(58. 0～108. 0lb-ft)
Tie rod end ball stud nuts
40～70N. m
4. 0～7. 0kg-m
(29. 0～50. 5lb-ft)
Drag link nuts
40～70N. m
4. 0～7. 0kg-m
(29. 0～50. 0lb-ft)
Tension rod nuts
40～60N. m
4. 0～6. 0kg-m
(29. 0～43. 0lb-ft)
Tie rod and Tie rod end
When installing the tie rods and the tie rod ends, as to R (right screw) and L (left screw) at the both ends of the tie rod, refer to Fig. 17-18.
After installing them, be sure to perform the toe-in adjustment. Both tie rods, right and left, must be adjusted uniformly. Refer to Fig. 17-19.
Steering center lever stopper bolt
When mounting the stopper bolts, adjust them so that the specified minimum turning radius is obtained, and then make sure to tighten the lock nut.
Steering center lever stopper bolt lock nuts
11～17N. m
1. 1～1. 7kg-m
(8. 0～12. 0lb-ft)
Tension rod bracket bolts
30～55N. m
3. 0～5. 5Kg-m
(22. 0～39. 5lb-ft)
Tension rod cotter pin
Make sure to bend the cotter pin as shown in the figure.
Tension rod bolt
Mount the tension rod bolts through the tension rod downward.
FRONT
Tension rod castle nut
60～100N. m
6. 0～10. 0kg-m
(43. 5～72. 0lb-ft)
Tension rod bush
Fit the two bushes so that their shorter outer diameter sides face each other. Also be sure to fit the spacers inside the bushes.
Tension rod washer
Refer to the figure for the installing direction of the tension rod washer.
Tie rod end lock nuts
50～75N. m
5. 0～7. 5kg-m
(36. 5～54. 0lb-ft)

Fig. *17-16*

Steering handwheel

Two requirements must be met, among others, in installing and setting the steering wheel; 1) check to be sure that the handwheel play meets the specification, and 2) set it in such a way that, with the front wheels pointing straightahead, its two spokes are horizontal, as shown in Fig. 17-17. (Within 6° of horizontal position)

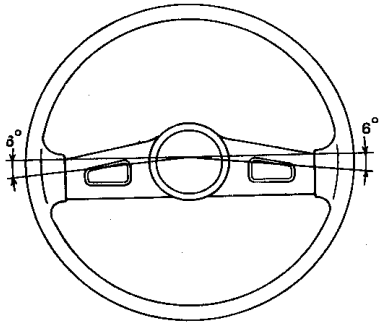
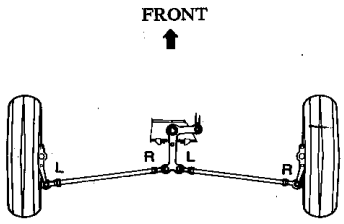


Fig. 17-17

Tie rod



L: Left screw
R: Right screw

Fig. 17-18

17-8. Wheel Alignment

Alignment service data

Toe-in	Vehicle with 4.50-12-8PR	11～15mm (0.433～0.590in.)
	Vehicle with 145R12-6PR	3～6mm (0.118～0.236in.)
Camber		1°30′
Trail		11mm(0.43in.)
Kingpin inclination		12°30′
Caster		2°30′

Adjustm ent

The only item of adjustment is toe-in . Camber and caster are given and fixed. Before checking and adjusting toe-in, let the car stand on flat level ground without any load placed aboard, and make sure that—

(1) All tires are inflated to the following pressures;

Unloaded

Tire pressure specification (vehicle with 4.50-12-8PR)

Front wheel tires	180kPa(1.8kg/cm², 26psi)
Rear wheel tires	180kPa(1.8kg/cm², 26psi)

(2) The car is level. (Check by using a carpenter′s level gauge.)

(3) The front wheels are set in staightahead driving position.

Using the toe-in gauge, read the toe-in and compare the reading against the specification (indicated above).

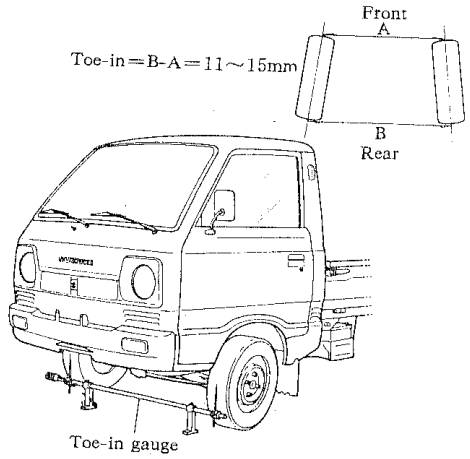


Fig. 17-19

To increase or decrease the toe-in, adjust the length of tie rods. This is accomplishec by loosening the four lock nuts②on the ends of each tie rod and by turning the rod①.

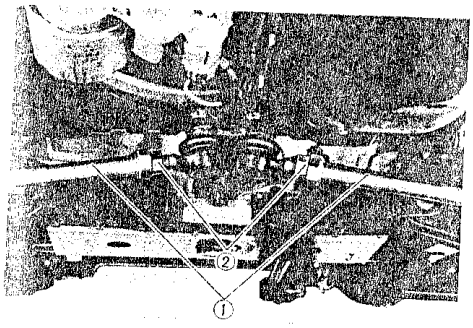


Fig. 17-20

17-9. Steering Angle

Steering angle	inside	33°
	outside	27°

Use the turning radius gauge when measuring the steering angle.

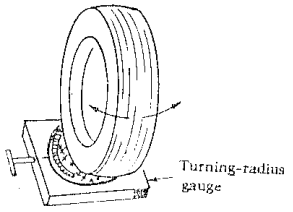


Fig. 17-21

If the steering angle is out of specification, adjust it by changing the length of the steering center lever stopper bolts③.

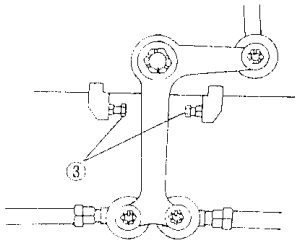


Fig. 17-22

NOTE:
After tightening the stopper bolt lock nuts firmly, turn the steering wheel all the way to the right and left and check to be sure that the narrowest clearance between the front tire and the tire house exceeds the value below.

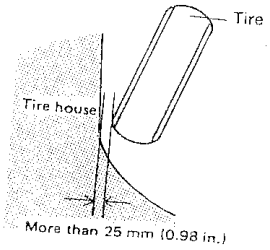


Fig. 17-23

17-10. Tightening Torque

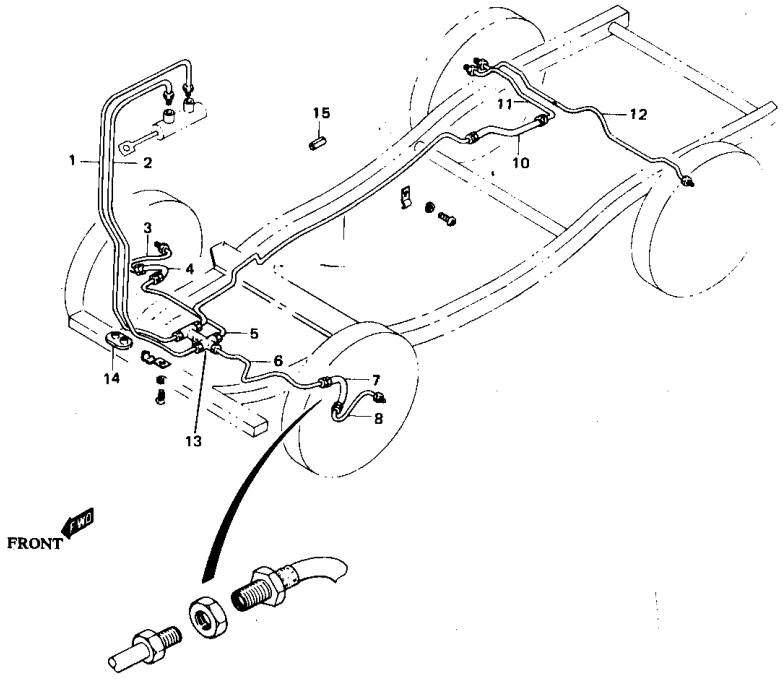
Fastening parts	N. M (kg-m)	lb-ft
Steering shaft nut	25～40 (2. 5～4. 0)	18. 0～28. 5
Steering flange joint bolt	20～30 (2. 0～3. 0)	14. 5～21. 5
Steering gear box bolt	70～90 (7. 0～9. 0)	51. 0～65. 0
Steering center lever nut	80～150 (8. 0～15. 0)	58. 0～108. 0
Tie rod end lock nut	50～75 (5. 0～7. 5)	36. 5～54. 0
Tie rod end ball stud nut	40～70 (4. 0～7. 0)	29. 0～50. 5
Drag link nut	40～70 (4. 0～7. 0)	29. 0～50. 5
Steering knuckle arm bolt	30～55 (3. 0～5. 5)	22. 0～39. 5
Steering rubber joint nuts	15～25 (1. 5～2. 5)	11. 0～18. 0

18. BRAKES

18-1. Description

The hydraulic foot brake system of the SC1010 has two leading shoes in the front wheel brakes, and one leading shoe and one trailing shoe in the rear wheel brakes. Hydraulic pressure is produced by a tandem master cylinder to actuate the wheel cylinders, two in each front wheel brake and one in each rear wheel brake, through two independent circuits, one for front brakes and one for rear brakes.

The parking brake is of mechanical type and utilizes the shoes in rear brakes. Pulling the parking lever mechanically forces the shoes against the drum; this force is transmitted through a linkage and wire cables.



1. Brake pipe No. 12
2. Brake pipe No. 1
3. Brake pipe No. 4
4. Front brake flexible hose
5. Brake pipe No. 2
6. Brake pipe No. 3
7. Front brake flexible hose
8. Brake pipe No. 5
9. Brake pipe No. 6
10. Rear brake flexible hose
11. Brake pipe No. 7
12. Brake pipe No. 8
13. 5-way joint
14. Brake pipe gromet
15. Protector

Fig. 18-1

18-2. Tandem Master Cylinder

The tandem master cylinder is similar in construction to an ordinary master cylinder, the principal differences being that it has two pistons and four piston cups and that hydraulic pressure is developed in two chambers, one for front brakes and the other for rear brakes.

Obviously the two-circuit foot brake system employed in the SC1010 models assures greater safety; failure of one circuit (failure of front brakes or rear brakes) due to such as an oil line rupture does not incapacitate the machine.

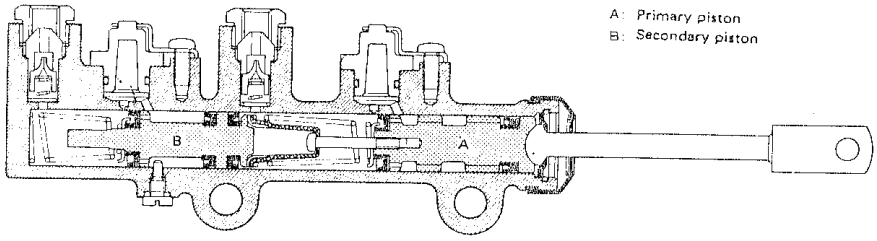


Fig. 18-2

18-3. Tandem Master Cylinder Operation

Normal operation

Depressing the brake pedal forces primary piston "A" toward the left (in Fig. 18-3) to pressurize the oil immediately ahead for front brades. By this pressure and by the force of return spring, secondary piston "B" moves similarly to pressurize the oil for rear brakes.

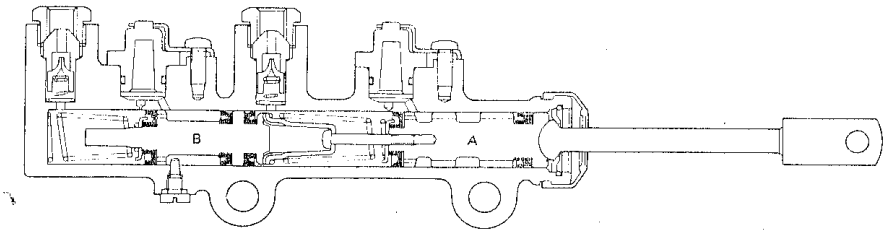


Fig. 18-3

One-circuit operation (front-brake circuit failure)

Depressing the brake pedal causes primary piston "A" to move as above but, because the front-brake circuit connot hold pressure, the oil immediately ahead of this piston does not get pressurized. As piston "A" keeps moving, compressing the spring, it begins to push piston "B" when the spring has been compressed fully. From this point on, piston "B" moves to pressurize the oil ahead and thus actuate the rear brakes.

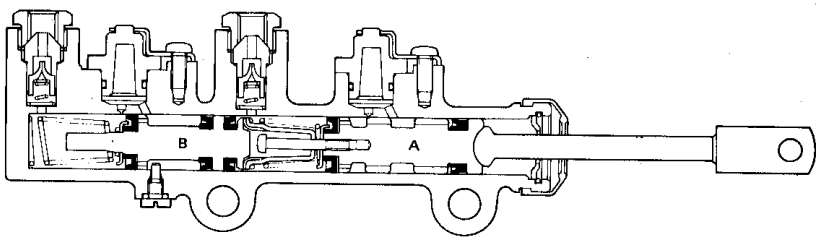


Fig. 18-4

One-circuit operation(rear-brake circuit failure)

In this case,the leftward movement of piston "A" has but little effect for front brakes at first,because the initial rise in oil pressure causes piston "B" to promptly yield and move toward the left. Very soon the forward end of piston"B"comes to and bears against the head of the cylinder. From this point on, the leftward movement of piston"A"becomes effective to pressurize the oil ahead of it for the front brakes. Fig. 18-5 shows secondary piston "B" at halt.

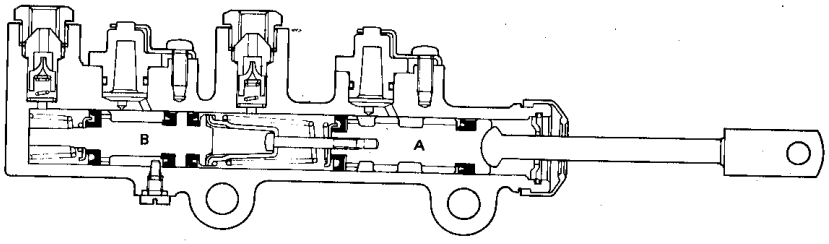


Fig. 18-5

18-4. Front Brake Construction

There are two wheel cylinders. Each cylinder has one piston,by which it pushes the leading end of its shoe. In other words,the two shoes begin to rub the drum in a "biting" manner the moment the hydraulic pressure applies to the wheel cylinders,and thus develop greater braking force more quickly as the pressure to the cylinder rises(when the machine is runing forward).

The shoes are mounted on the backing plate in a floating manner,each being urged by the return spring in the contracting direction and pivoted at its trailing end.

Each wheel cylinder is complete with an adjuster consisting of a notched wheel and a bolt. Turning this wheel advances or retracts the bolt(on which the trailing end of the shoe pivots)to reduce or increase the shoe-to-drum clearance (brake adjustment). The two cylinders are bolted to the backing plate;and their adjusting wheels are accessible through holes provided in the brake drum.

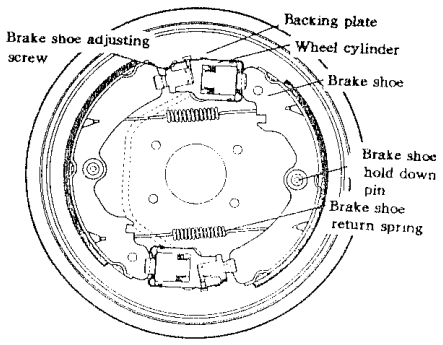


Fig. 18-6.

18-5. Rear Brake Construction

The rear brake has a double-piston type wheel cylinder interposed between the leading end of one shoe and the trailing end of the other. The other ends of these shoes pivot on the adjuster sleeve complete with an adjusting screw.

When hydraulic pressure applies to the wheel cylinder, which is bolted to the backing plate, the two pushrods of this cylinder move out to spread the shoes apart against force of two return springs.

Brake adjustment is to be effected by turning the notched screw of the adjuster sleeve. This screw is accessible through a hole provided in the brake drum.

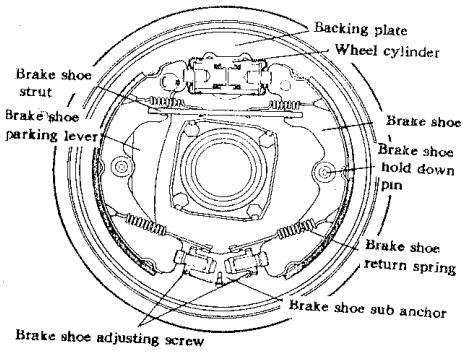


Fig. 18-7

18-6. Parking Brake Construction

For the purpose of utilizing the shoes in the rear brake, the parking brake system uses a brake shoe lever and a strut in addition to the wire cable for transmitting the manual effort (exerted to the parking lever) to the rear brakes. The shoe lever and strut are mounted on the backing plate of each brake in a floating manner.

The strut is to parking brake what the wheel cylinder is to foot brake. Pulling the parking lever causes the strut to expand the two shoes and push them against the drum.

18-7. Wheel Cylinder Construction

The double-piston cylinder used in the rear brake has two pistons, each backed by a cup and fronted by a boot. A pushrod or actuating pin bears, against the piston by its inner end and is fitted to the shoe web by its outer end.

The single piston cylinder, two of which are used in the front brake, is similar to the double-piston one, except that it has one piston, with its other end being complete with the adjuster.

A bleeder screw is provided in the cylinder proper. This screw is a plug; it is to be removed only when air trapped in the circuit has to be vented out.

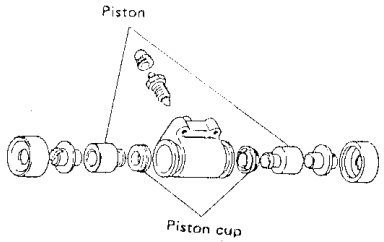


Fig. 18—8

18-8. Maintenance Services

Master Cylinder

Complaints on the master cylinder are in most cases traceable to excessively worn piston cups; experience tells us that primary cause of malcondition is the impurities, paticularly abrasive or gritty matters, that have entered the brake fluid reservoir. Check the master cylinder for the possibility of malcondition. The internals of the master cylinder should be replaced at regular intervals, and they should be handled as a kit. The recommended interval is two years.

Master cylinder internals replacement interval	2(two)years

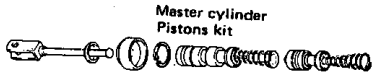


Fig. 18-9

The overall length of the primary piston sub-assembly is specified to be 94. 1mm(3. 704in.). This specification assumes great importance in the function of the master cylinder. When rebuilding this sub-assembly after its disassembly for overhaul or for replacement of piston cups, be sure to set the overall length to the specification value by means of the forming screw.

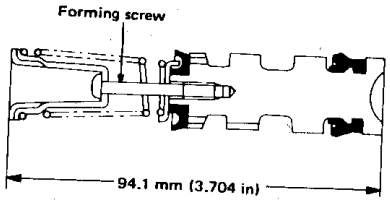


Fig. 18-10

Brake drum

Inspect the drum for cleanliness. Remove oil stains, if any. Check the wear of its braking surface by measuring its inside diameter, and determine its "out-of-round" from ID readings. The braking surface with groovy wear can be repaired by turning in a lathe if machining stock is available; a minor "out-of-round" can be corrected also by turning. A drum cracked or distorted or worn beyond repair must be replaced.

	Standard	Service limit
Brake drum inside diameter	220mm (8. 66in.)	222mm (8. 74in.)
Brake drum "out-of-round"	0	0. 5mm (0. 02in.)

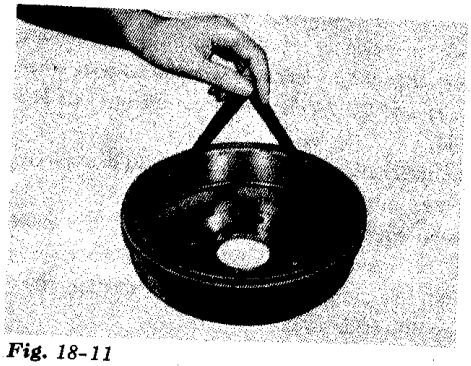


Fig. 18-11

Brake shoes

Glazed surfaces, if any, of brake shoes can and must be reconditioned by grinding with sand paper. Oil stains too can be removed similarly. Where the lining is worn beyond the service limit, the shoe must be replaced.

	Stand	Service limit
Brake lining thickness (lining +shoe rim)	7. 5mm (0. 27in.)	3mm (0. 12in.)

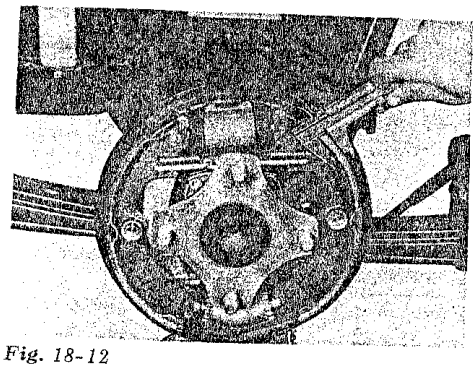


Fig. 18-12

Master cylinder and wheel cylinders

If brake fluid leakage from master or wheel cylinders is found, inspect piston cups for wear and for evidence of deterioration, and replace them if found in defective condition, even when the end of the regular replacement intervals is a head.

The internals of each cylinder are to be replaced as a kit at regular intervals.

Piston cups and boots are of rubber; they must not be washed with gasoline or similar washing fluid. Use the brake fluid to wash them, or they may distort or swell.

Cylinder internals replacement interval	2(two)years

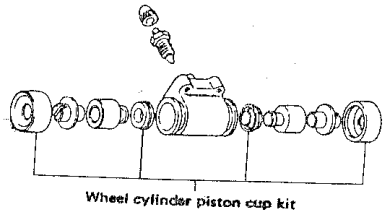


Fig. 18-13

Brake pipes

The brake pipes are double-layer wound type, made by rolling steel strip into a two-layer wall pipe, With its surfaces treated for rust prevention. After driving the machine along in sea water at the beach or in a shore area full of salt sprays, it is a good practice to wash the brake pipes with soft water.

Inspect the brake pipes in regard to the following items
(1)Cut marks or dents
(2)Leakage of brake fluid
(3)Signs of rubbing at the clamps and clips
(4)Rusting or corrosion

Air purging

Whenever any component or part of the foot brake system has been replaced, reconnected or otherwise worked on to expose the brakefluid side of the circuit to the atmosphere, some air will get into the circuit; and the presence of such air will result in a "spongy" brake pedal. In such a case, or whenever the presence of air in the circuit is suspected, carry out an "air purging" operation at each wheel cylinder, as follows:

(1) Tie a transparent vinyl tube ① into the bleeder plug of the wheel cylinder (in order to catch the brake fluid).

(2) Pump the brake pedal several times and depress the pedal all the way.

(3) Loosen the bleeder plug by turning it a half rotation. The fluid with air bubbles will come out. Tighten up the plug when air bubbles stop coming out.

This operation requires two persons, one at the brake pedal and one at the wheel cylinder.

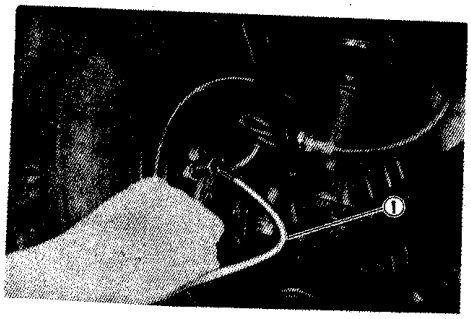


Fig. 18-14

Brake fluid

The brake system uses a glycol type brake fluid. When purchasing the replacement fluid, be sure to specify the glycol type meeting the following specifications:

Brake Fluid	Specifications
	DOT3, DOT4, SAEJ1703 (Synthetic brake fluid)

Some commercially available brake fluids are of silicone or petroleum base; do not use any of these fluid. Remember, any brake fluid which is a mixture of two or more brands is likely to effect some of the brake system components adversely, resulting in faulty braking.

The brake fluid in service is subject to gradual deterioration because the moisture content of air finds its way slowly into the brake fluid. For this reason the brake fluid should be regarded as an expenable item and be replaced at regular intervals.

Brake fluid change interval	2(two)years

Brake shoe clearance adjustment

The hole for gaining access to the adjusting wheel or screw is provided in the brake drum. Through this hole, insert a screwdriver to turn the adjusting wheel or screw.

Turn the wheel or screw to expand the shoe all the way, reducing the clearance to zero, and then turn it back 3 to 6 notches to introduce a drum-to-shoe clearance. Leave the adjusting wheel or screw right there.

Brake shoe clearance adjustment	Back away 3 to 6 notches

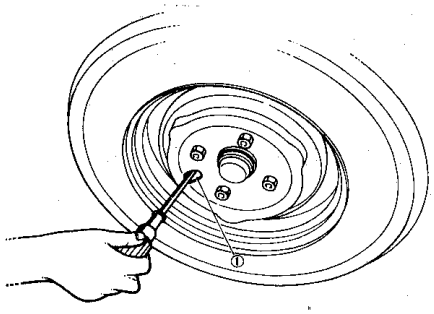


Fig. 18-15

Brake pedal

Confirm that clearance ② between the wall and the pedal arm is more than *45*mm (*1. 77*in.) when the pedal is depressed by a load of approx. *30*Kg (*66*lb). If the clearance is less than *45*mm (*1. 77*in.), adjust the brake shoe clearance to obtain the specified value.

CAUTION:

• If the specified clearance cannot be obtained, or the feel is spongy when the pedal is depressed, check the shoes for excessive wear and the brake system for air entered.

• After reassembling the brake oil line, bleed air from the line.

NOTE:

Inspect pedal clearance daily, as well as at periodically scheduled inspection.

Fig. 18-16

Pedal travel	*15*～*20*mm (*0.59*～*0.78*in.)
Pedal-to-wall clearance ② (when pedal is depressed at *30*kg(*66*lb))	*50*mm minimum

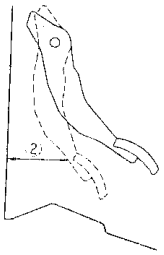


Fig. 18-16-1

Parking brake lever

Pull up the parking brake lever all the way with one hand to apply brake fully, and see how many notches of the ratchet of the lever has traversed. If the lever moves by more than *5* notches, it means that the shoe-to-drum clearance in the rear brakes is too much and needs to be readjusted to the specification. Through the hole provided in the brake drum, insert a screwdriver and back away the adjusting screw *3* to *6* notches from its zero-clearance position, as in the case of the wheel brake.

Parking brake stroke	*5* notches maximum
Brake shoe clearance adjustment	Back away *3* to *6* notches

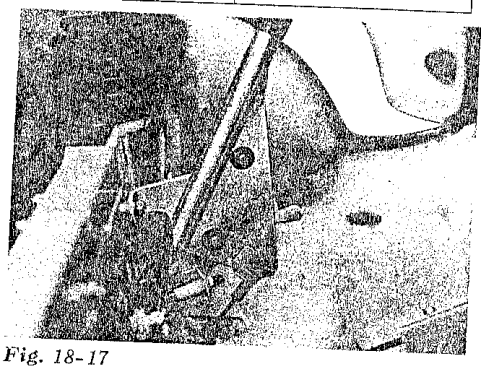


Fig. 18-17

Parking brake cable

Inspect the brake cable for damage, and check for smoothness of its movement. Oil the cable as necessary. A defective cable must be replaced. Advise the user to inspect and service the cable in this manner at regular intervals.

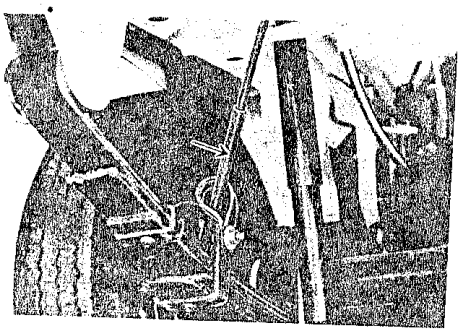


Fig. 18-18

Brake hoses and pipes

These are critical safety parts and demand greater attention. Be always sure that the hoses and pipes are in good condition, free of any evidence of crack or breakage. A damaged hose or pipe or a rusted or leaking one must be replaced.

CAUTION:
After replacing any of the brake pipes or hoses, be sure carry out an air bleeding operation. You are duty-bound to do this before releasing the serviced machine to the user.

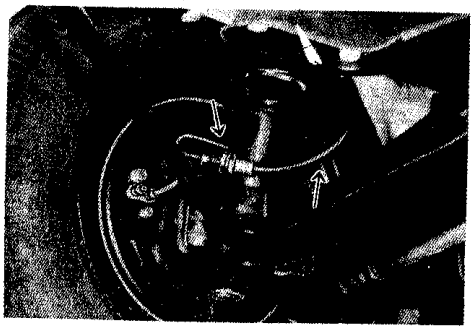


Fig. 18-19

Tightening torque
10～15N. m
1. 0～1. 5Kg-m
(7. 5～10. 5lb-ft)

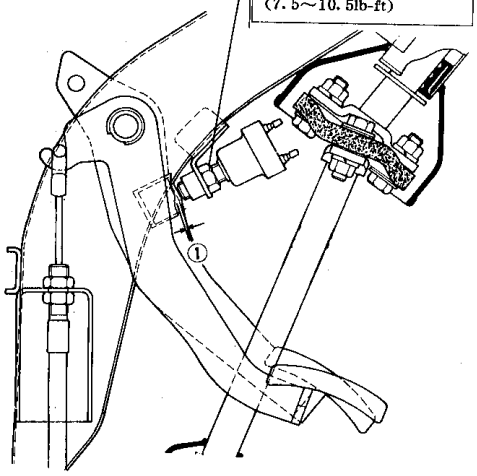
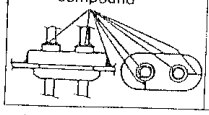


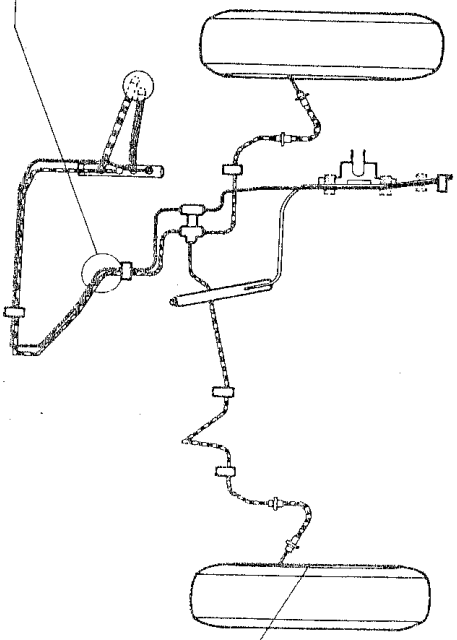
Fig. 18-20

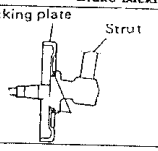
18-9. Important Steps in Installation

Brake light switch

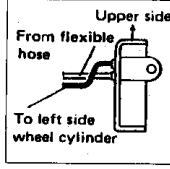
When reinstalling the switch, adjust it to make the clearance①between the brake pedal and the screw end of the switch is 0. 1～0. 6mm(0. 004 ～ 0. 024in) when the brake pedal is released. Following the above adjustment, tighten the nut to the specified torque and check if the brake lights come on.

Brake pipe grommet	
	When putting on the grommet, apply SEALING COMPOUND GY163 to the illustrated points from inside the cabin.



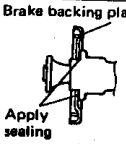
Brake backing plate(Right&Left)	
	When installing the backing plate onto the strut, apply SEALING COMPOUND (anaerobic cement GY163) to the mating surfaces of both parts.

Brake pipes (Right side)

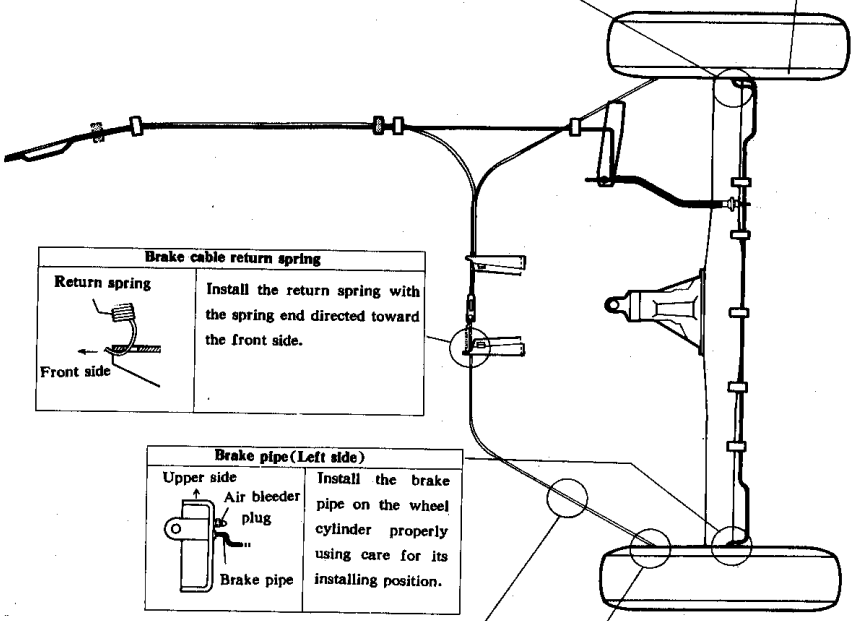


Install the brake pipe on the wheel cylinder properly using care for its installing position.
Brake backing plate (Right & Left)

Brake backing plate (Right & Left)



When installing the backing plate onto the axle housing, apply SEALING COMPOUND (anaerobic cement GY*168*) to the mating surfaces of both parts.



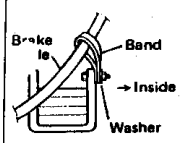
Brake cable return spring

Install the return spring with the spring end directed toward the front side.

Brake pipe (Left side)

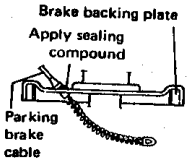
Install the brake pipe on the wheel cylinder properly using care for its installing position.

Parking brake cable band (Right & Left)



Attach the cable band at the illustrated position of the reef spring clamp.

Parking brake cable (Right & Left)



When installing the cable, apply SEALING COMPOUND (anaerobic cement GY*168*) to the illustrated position of the cable.

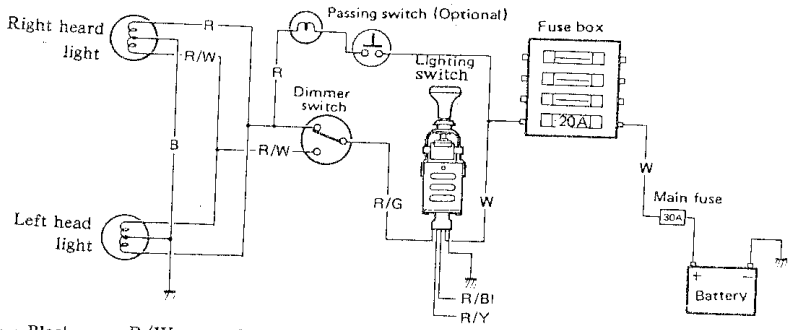
18-10. Tightening Torque

Fastening parts	N. m(Kg-m)	lb-ft
Brake pedal shaft nut	18～28 (1. 8～2. 8)	13. 5～20. 0
Master cylinder nut	25～40 (2. 5～4. 0)	18. 5～28. 5
Tube union nut	15～18 (1. 5～1. 8)	11. 0～13. 0
Flexible hose nut	20～40 (2. 0～4. 0)	14. 5～28. 5
5-way joint bolt	4～7 (0. 4～0. 7)	3. 0～5. 0
Backing plate bolt	18～28 (1. 8～2. 8)	13. 5～20. 0

19. BODY ELECTRICAL EQUIPMENT

19-1. Head Light

Wiring circuit



B·····Black
R·····Red
W·····White
R/W·····Red with white tracer
R/Bl·····Red with blue tracer
R/Y·····Red with yellow tracer

Fig. 19-1

Headlight beam setting (standard)

Before measuring or adjusting the headlight beam, adjust air pressure of the 4 tires to the specified value and let the vehicle unloaded and in level. Then move the vehicle onto a flat surface. There are various measuring methods (e. g. screen method, using focusing type tester, etc.). The method described in this manual does not use a tester.

(1) Vertical beam alignment

Unless otherwise prescribed by the local statutory regulations, set the head lights in such a way that a screen is hung in front of the head lights, the distance between the screen (or white wall) and the lights is 10 meters. The center axis of the vehicle crosses the screen at right angle. Adjust the main beam axis to be within a fifth 1/5 of the head light height.

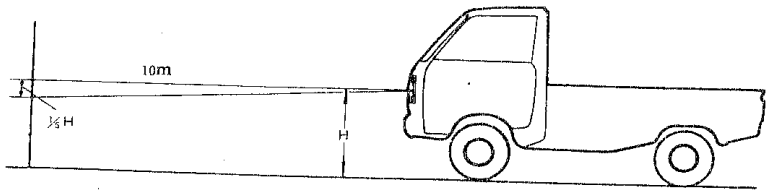


Fig. 19-2

(2)Horizontal beam alignment(Right-hand steering vehicle)

The set-up is the same as in Fig. 19-2. For the left-hand steering model, the alignment is the mirror image of what is prescribed here.

RIGHT HEAD LIGHT: Determine the point(A)straightahead of the light, and align the main beam axis so that the axis will strike a spot within 100 mm(3. 94 in.)to the right or 200 mm (7. 87in.) to the left of the straightahead point.

LEFT HEAD LIGHT: Determine the point(B)straightahead of the light, and align the main beam axis so that the axis will strike a spot within 200 mm (7. 87in.)on either side of the said point.

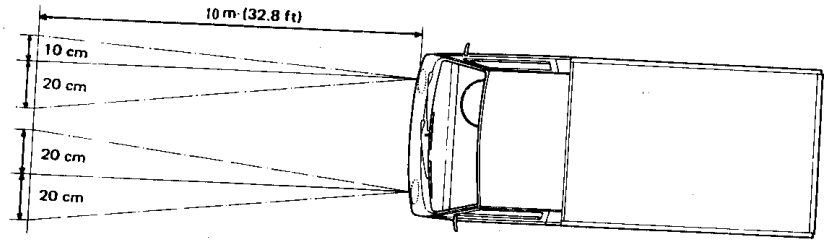


Fig. 19-3

Maintenance

(1)Head light adjustment

There are three screws; 1, 2, and 3. By means of these screws, adjust the light position for beam alignment.

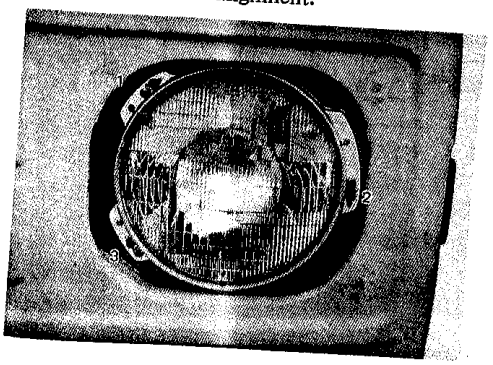


Fig. 19-4

(2)Head light dimmer switch

Using a circuit tester, check the respective circuits for continuity by putting the tester probe pins to the terminals shown in Fig. 19-6. With the switch kept in LOW BEAM position, the tester should indicate continuity between terminals ①and (23). Similarly, there should be continuity between terminals ② and (23) when the switch in HIGH BEAM position.

19	20	5	23	2	1
17	22	30	31	6	4

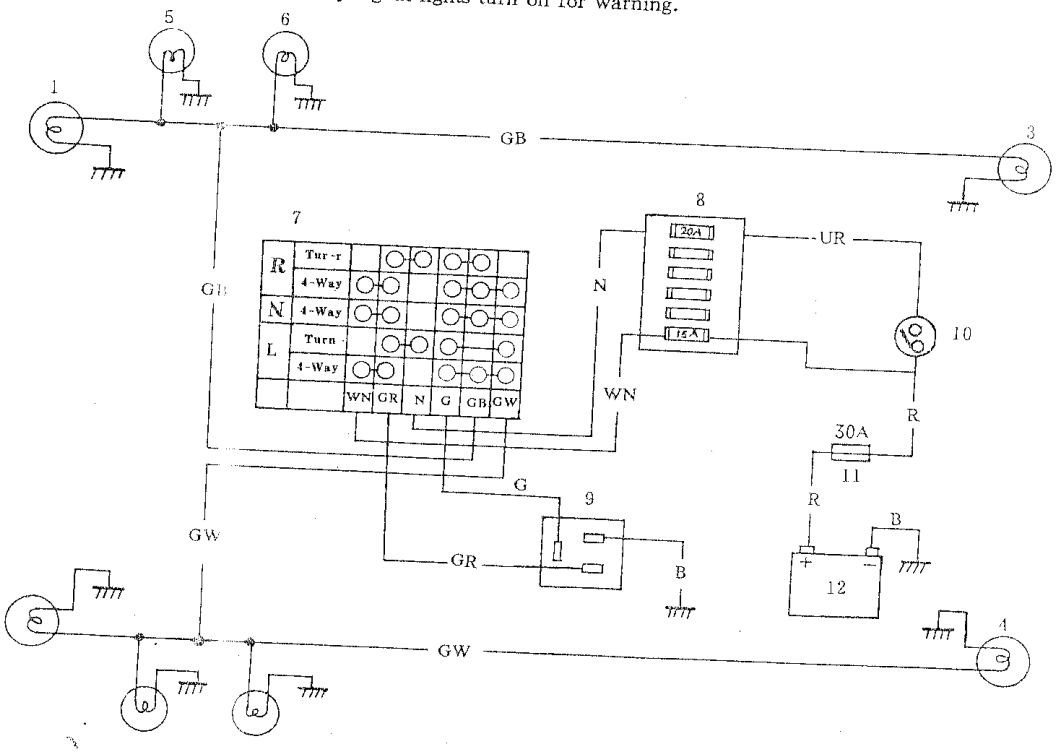
1. BLUE/WHITE
2. BLUE/BLACK
4. GREEN/WHITE
5. YELLOW/WHITE
6. GREEN/BLACK
17. BROWN/BLACK
19. GREEN/BLUE
20. GREEN/BROWN
22. WHITE/BROWN
23. BLUE/YELLOW
30. GREEN/RED
31. GREEN

Fig. 19-5

19-2. Turn Signal Light and Hazard Warning Light

Circuit description

When the switch 10 is on, when the turn-signal switch is on for a left turn, brown lead is connected to green/red lead and green lead to green/white lead, the left turning light is on. When for right turn, green lead is connected to green/black lead, the right one is on. When the 4-way warning light switch is on, white/brown lead is connected to green/red lead, green lead is connected to green/black and green/white respectively, the 4-way signal lights turn on for warning.



1. conbination headlights(for right turn)
2. conbination headlights(for left turn)
3. conbination rear lights(for right turn)
4. conbination rear lights(for left turn)
5. turn signal light(right, left)
6. meter pilot light(right, left)
7. conbination switch(turn signal switch)
8. 6-way fuse box
9. transistor flasher
10. ignitor switch
11. fuse box
12. battery

Fig. 19-16

Inspection

(1)Trouble diagnosis

Symptom	Possible cause
1. Lamps will not come on in either group. 2. Hazard light comes on but turn signal lights will not. 3. No light comes on;or lights light up but do not flicker. 4. Turn signal lights are satisfactory, but hazard light will not come on. 5. Flickering frequency is erratic;or lights remain lit. 6. Turning on hazard warning switch lights up only one group of lights.	Fusible link in 30-A fuse is blown off. Open circuit (due to poor point contact) in turn signal dimmer switch. Defective relay unit. Open circuit in hazard warning switch. Light bulbs are defective or improperly grounded. Defective contact in dimmer switch.

(2)Dimmer switch

Using a circuit tester, check for continuity between each pair of terminals by referring to the chart given in Fig. 19-5. for each position of the dimmer switch lever. Discontinuity means that contact points are burnt or otherwise defective in the switch.

The switch is in sound condition if continuity is noted between terminals 31 and 6 with the lever in right-turn position, and between terminals 4 and 31 with the lever in left-turn position.

NOTE:
The turn signal switch is in sound condition if continuity is noted between terminals (30)and Brown. Similarly, the hazard warning switch is in sound condition if continuity is noted between terminals (30)and (22).

19-3. Windshield Wiper Motor

Circuit description

The circuit for powering the wiper motor is complete with a device for automatically bringing the wiper blade to a certain(laid-down)position when the wiper switch is turned off.

Referring to the circuit diagram of Fig. 19-8, assume that the main switch is in closed position. Turning on the wiper switch feeds current from the battery to the wiper motor, and the motor starts up and swings the blade. In the gear mechanism for converting the rotary motion of the motor into the swinging motion of the blade, the contact-actuating cam is mounted on the final gear shaft.

The cam keeps rotating and , for each rotation, momentarily connects P0 to P1 and then to P2. This alter nating make-break action does not affect the running wiper motor.

Under this condition, turn off the wiper switch just when the blade is up and in the midst of swing motion. This alters the supply circuit of the motor;current now flows through P2 and P0 and another pair of contact points in the wiper switch and into the motor. Thus, the motor is enabled to continue its run.

A moment later, the blade comes to the laid-down position. At this time, P0 separates from P2 but contacts points P1, thereby shunting the motor. Upon loss of current, the motor develops counterelectromotive force in its armature. Through the shunt circuit, the current induced by this force (voltage) flows to halt the motor, so that the blade halts at the designated position.

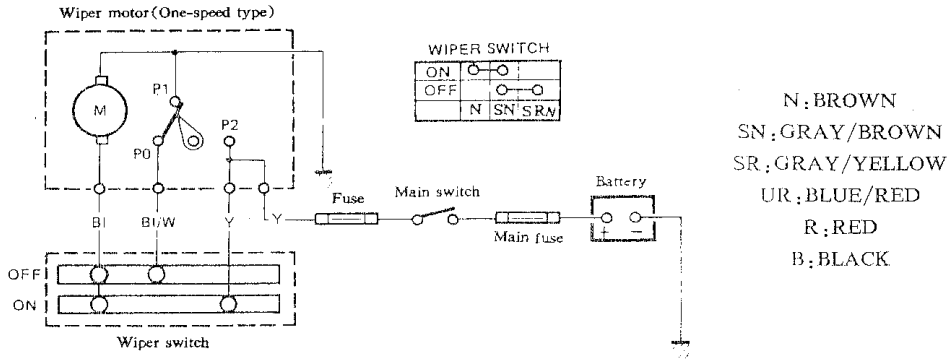


Fig. 19-7

Maintenance

(1)Wiper trouble diagnosis

If the wiper switch is ineffective in cutting the wiper into service, the wiper circuit must be checked with the following three possibilities in mind:

(a)Any of the fuses in the circuit could have failed.

(b)Circuit is open in the wiper swtich. (To check the switch, disconnect the coupler of the wire leading to the wiper motor, turn on the switch and read the voltage between ground and GRAY/BROWN. If 12 volts is read, then the switch is in good condition.)

(c)Armature coil could be in open-circuited condition in the motor; or commutator brushes are not seating properly. (The motor is in sound condition if continuity is noted between motor ground and BLUE wire.)

19-4. Fuel Gauge

Circuit description

The fuel gauge for visually telling how full the fuel tank is an electrical instrument comprising a float-actuated potentiometer type of tank unit and a bimetal type indicator (meter)mounted on the instrument panel.

Two bimetal elements are used in the indicating unit, one for deflecting the indicating hand over the "E"to "F"scale and the other(regulator)for on-off control of current.

When fuel level is low in the tank, the float is low and hence a larger ohmic resistance is introduced into the circuit by the potentiometer element in the tank unit. Consequently, a smaller current flows through the windings of the two bimetal elements, so that bimetal deflection is smaller and the indicating hand stays closer to"E"(for empty)side.

The bimetal element of the regulator bimetal draws an additional current. By the total current, the bimetal element deflects to open the circuit and, upon cooling, closes the circuit. In other words, the regulator makes and breaks the circuit intermittently. The average current is fairly constant under varying voltage condition of the battery because a higher battery voltage extends the duration of each contact point separation in the regulator.

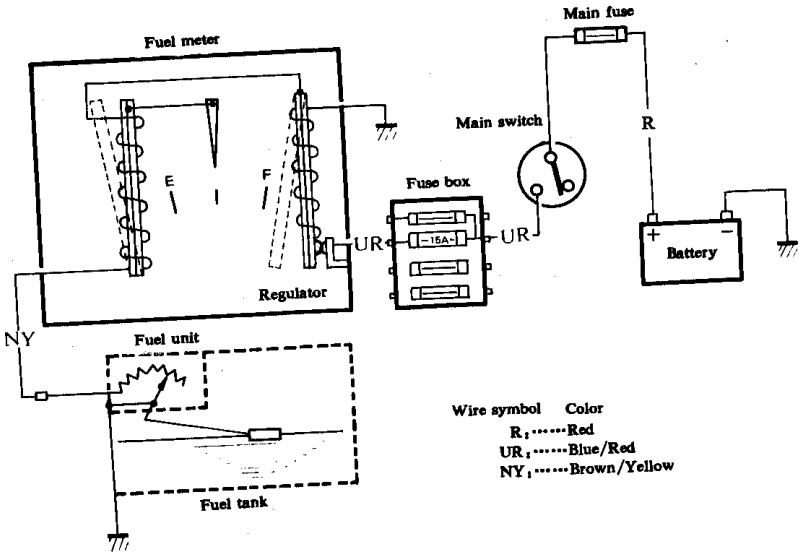


Fig. *19-8*

Inspection

The following checks are necessary when the fuel meter indication is false:

①Make sure both the tank unit and fuel tank are properly and securely grounded. If ground connection is loose, current will be small and the indicating hand will be down.

②Make sure that the regulator is properly and securely grounded. If high resistance exists in this ground circuit, the regulator draws but a small current, so that the duration of contact closure is much longer and, consequently, the average current through the other winding will be larger, resulting in a hand deflected closer to "F"position.

③Make sure that the float in the fuel tank is free from interference and without any hitch on its float arm, and that its stopper is correctly positioned.

An indicating meter checked to be internally defective must be replaced by a new one.

19-5. Wiring Diagram

20. SERVICE DATA AND MAINTENANCE SCHEDULES

20-1. Tightening Torque

In threaded fastening parts holding down a component in place, the holding force is preserved primarily in the male and female threads in contact. Screw threads are capable of withstanding this force up to a certain limit. Here occurs the need to tighten them without exceeding the limit, and this need can be met by using torque wrenches.
Fastening parts, for which the limit is specified because their fastening or holding function is critical, is listed below. Use torque wrenches and adhere to the torque specifications when tightening them at the time of periodical inspection or overhauling or servicing.

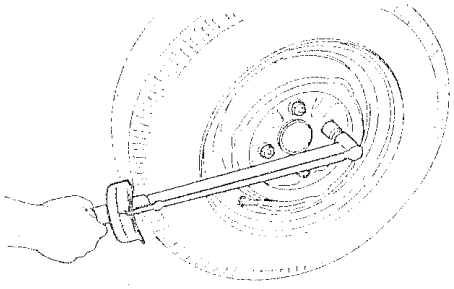


Fig. 20-1

System	Fastening Parts	Tightening torque		
		N·M	kg-m	lb-ft
Engine	Cylinder head bolt	55～60	5.5～6.0	40.0～43.0
	Spark Plug	20～30	2.0～3.0	14.5～21.5
	Inlet&exhaust manifold nut	18～23	1.8～2.3	13.0～16.5
	Camshaft timing pully bolt	50～60	5.0～6.0	36.5～43.0
	Valve adjusting nut	15～20	1.5～2.0	11.0～14.5
	Timing belt cover bolt	3～4	0.3～0.4	2.5
	Engine crankshaft pully bolt	50～60	5.0～6.0	36.5～43.0
	Connecting rod bearing cap nut	28～32	2.8～3.2	20.5～23.0
	Crankshaft bearing cap bolt	43～48	4.3～4.8	31.5～34.5
	Flywheel bolt	40～45	4.0～4.5	29.0～32.5
	Oil pressure unit	12～15	1.2～1.5	9.0～10.5
	Oil filter assy	10～15	1.0～1.5	7.5～10.5
	Oil filter stand	20～25	2.0～2.5	14.5～18.0
	Engine rear mounting nut and bracket bolt	11～14	1.1～1.4	8.0～10.0
	Relief valve spring retainer	15～20	1.5～2.0	11.0～14.5
	Oil pan bolt	4～5	0.4～0.5	3.0～3.5
	Oil drain plug	20～25	2.0～2.5	14.5～18.0
	Engine mount bracket bolt (cylinder and body)	30～40	3.0～4.0	22.0～28.5
	Engine rear and front mounting nut	23～28	2.3～2.8	16.5～20.0
	Cylinder head cover bolt	4～5	0.4～0.5	3.0～3.5
Gearshifting control	Gear shift arm nut	9～14	0.9～1.4	7.0～10.0
	Gear select arm nut	9～14	0.9～1.4	7.0～10.0
Transmission	Transmission case bolt	15～20	1.5～2.0	11.0～14.5
	Oil drain plug and level plug	30～50	3.0～5.0	22.0～36.0
	Extension case bolt	15～20	1.5～2.0	11.0～14.5
	Rear mounting bolt	15～20	1.5～2.0	11.0～14.5
	Gearshift lever case bolt(8mm)	9～12	0.9～1.2	7.0～8.5
	Gearshift lever case bolt(6mm)	6～10	0.6～1.0	4.3～7.0
	Stopper plate for shifter fork shaft	15～20	1.5～2.0	11.0～14.5

System	Fastening Parts	Tightening torque		
		N·M	kg-m	lb-ft
Differential	Cross joint flange yoke bolt	15～25	1.5～2.5	11.0～18.0
	Side bearing cap nut	20～25	2.0～2.5	14.5～18.0
	Drive bevel gear bolt	65～80	6.5～8.0	47.0～57.5
	Drive bevel pinion nut	110～170	11.0～17.0	80.0～123.0
	Differential carrier nut	15～20	1.5～2.0	11.0～16.5
	Oil drain plug	40～70	4.0～7.0	29.0～50.0
Suspension	Shackle pin nut	30～55	3.0～5.5	22.0～39.5
	Reef spring nut	45～70	4.5～7.0	32.5～50.5
	Reef spring U bolt nut	30～45	3.0～4.5	22.0～32.5
	Steering knuckle nut	80～120	8.0～12.0	58.0～86.5
	Front strut lock nut	70～90	7.0～9.0	5.0～65.0
	Front strut support nut	10～18	1.0～1.8	7.5～13.0
	Ball joint stud castle nut	40～70	4.0～7.0	29.0～50.5
	Wheel nut	60～80	6.0～8.0	43.5～57.5
	Front suspension arm shaft nut	40～60	4.0～6.0	29.0～43.0
	Tension rod nut	40～60	4.0～6.0	29.0～43.0
	Tension rod castle nut	60～100	6.0～10.0	43.5～72.0
	Tension rod bracket bolt	30～55	3.0～5.5	22.0～39.5
Streering	Steering shaft nut	25～40	2.5～4.0	18.0～28.5
	Steering rubber joint nut	15～25	1.5～2.5	11.0～18.0
	Steering rubber joint flange bolt	20～30	2.0～3.0	14.5～21.5
	Steering gear box bolt &nut	70～90	7.0～9.0	51.0～65.0
	Steering knuckle bolt	40～55	4.0～5.5	29.0～39.5
	Steering center lever nut	80～150	8.0～15.0	58.0～108.0
	Tie rod end lock nut	50～75	5.0～7.5	36.5～54.0
	Tie rod end ball stud nut & Drag ling nut	40～70	4.0～7.0	29.0～50.5

System	Fastening Parts	Tightening torque		
		N·M	kg-m	lb-ft
Brake	Brake backing plate bolt and nut	18～28	1.8～2.8	18.0～20.0
	Brake master cylinder nut	25～40	2.5～4.0	18.5～28.5
	Brake tube union nut	15～18	1.5～1.8	11.0～13.0
	Brake flexible hose nut	20～40	2.0～4.0	14.5～28.5
	Brake shoe adjusting nut	6～9	0.6～0.9	4.5～6.5
	Brake pipe 5-way joint bolt	4～7	0.4～0.7	3.0～5.0
	Brake pedal bolt nut	18～28	1.8～2.8	13.5～20.0

For other bolts and nuts not listed above, refer to this chart:

20-2. Service Data

ENGINE

Item			Standard	Service Limit
Compression pressure			1128kpa 300r/min	981kpa 300r/min
	Difference between cylinders		———	98kpa 300r/min
Valve clearance (Inlet, Exhaust)	Cold		0.13～0.18mm(0.005～0.007in.)	———
	Hot		0.23～0.28mm(0.009～0.011in.)	———
Ignition Timing			10°± 1° B. T. D. C. at 900r/min (rpm)	———
Cylinder head	Flatness of gasketed surface		———	0.05mm(0.002in.)
	Flatness of manifold seat	Inlet	———	0.1mm(0.004in.)
		Outlet	———	0.1mm(0.004in.)
	Valve seat	Seating width Inlet	1.3～1.5mm(0.0512～0.0590in.)	———
		Seating width Exhaust	1.3～1.5mm(0.0512～0.0590in.)	———
		Seating angle	45°	———

Item			Standard	Service Limit
Valve, valve spring & cam-shaft	Camshaft/Journal clearance		0.050～0.091mm (0.0020～0.0036in.)	0.15mm(0.0059in.)
	Camshaft thrust clearance		0.050～0.150mm (0.0019～0.0059in.)	0.30mm(0.0118in.)
	Cam height (Base circle +lift)	Inlet	36.152mm(1.4233in.)	36.100mm(1.4212in.)
		Exhaust	36.152mm(1.4233in.)	36.100mm(1.4212in.)
		Fuel pump cam	33.300mm(1.3110in.)	33.000mm(1.2992in.)
	Camshaft deflection		———	0.10mm(0.0039in.)
	Valve stem diameter	Inlet	6.965～6.980mm (0.2742～0.2748in.)	———
		Exhaust	6.955～6.970mm (0.2738～0.2744in.)	———
	Valve guide I.D.	Inlet	7.000～7.015mm (0.2755～0.2761in.)	———
		Exhaust	7.000～7.015mm (0.2755～0.2761in.)	———
	Valve guide-to-valve stem clearance	Inlet	0.020～0.050mm (0.0008～0.0019in.)	0.07mm(0.0027in.)
		Exhaust	0.030～0.060mm (0.0012～0.0023in.)	0.09mm(0.0035in.)
Valve, valve spring & cam-shaft	Thickness of valve head periphery	Inlet	0.80～1.20mm (0.0315～0.0472in.)	0.6mm(0.0236in.)
		Exhaust	0.80～1.20mm (0.0315～0.0472in.)	0.7mm(0.0275in.)
	Contact width of valve and valve seat	Inlet	1.3～1.5mm (0.0512～0.0590in.)	———
		Exhaust	1.3～1.5mm (0.0512～0.0590in.)	———
	Valve spring free length	Inlet	47.7mm(1.8779in.)	46.5mm(1.8307in.)
		Exhaust	47.7mm(1.8779in.)	46.5mm(1.8307in.)
	Valve spring preload	Inlet	255～294N for fitting length 40mm (1.57in.)	235N for fitting length 40mm (1.57in.)
		Exhaust	255～294N for fitting length 40mm (1.57in.)	235N for fitting length 40mm (1.57in.)
Rocker arm shaft and rocker arm	Rocker shaft O.D.		14.965～14.980mm (0.589～0.590in.)	———
	Rocker arm I.D.		14.985～15.005mm (0.590～0.591in.)	———
	Shaft-to-arm clearance	Inlet	0.005～0.040mm (0.0002～0.0016in.)	0.07mm(0.0027in.)
		Exhaust	0.005～0.040mm (0.0002～0.0016in.)	0.07mm(0.0027in.)
	Rocker shaft deflection		———	0.06mm(0.0023in.)

Item			Standard	Service Limit
cylinder	Flatness of gasketed surface		———	0.05mm(0.0020in.)
	Cylinder bore(S.T.D.)		62.005～62.020mm (2.4411～2.4417in.)	———
	Difference in bore between cylinders		———	0.05mm(0.0020in.)
	Wear limit on bore		———	0.05mm(0.0020in.)
	Cylinder-to-piston clearance		0.040～0.050mm (0.0016～0.0020in.)	———
Piston	Piston diameter	Standard	61.960～61.975mm (2.4393～2.4399in.)	———
		Oversize: 0.50mm (0.0196in.)	62.460～62.475mm (2.4590～2.4596in.)	———
	Piston ring groove width	Top ring	1.52～1.54mm (0.0598～0.0606in.)	———
		2nd ring	1.51～1.53mm (0.0594～0.0602in.)	———
		Oil ring	2.81～2.83mm (0.1106～0.1114in.)	———
	Piston pin diameter		15.995～16.000mm (0.6297～0.6299in.)	———
	Piston pin clearance in con. rod		0.003～0.016mm (0.0001～0.0006in.)	0.05mm(0.0020in.)
Piston ring	Piston ring thickness	Top ring	1.47～1.49mm (0.0578～0.0586in.)	———
		2nd ring	1.47～1.49mm (0.0578～0.0586in.)	———
		Oil ring	0.45mm(0.0177in.)	———
	Ring clearance in groove	Top ring	0.03～0.07mm (0.0012～0.0027in.)	0.12mm(0.0047in.)
		2nd ring	0.02～0.06mm (0.0008～0.0023in.)	0.10mm(0.0039in.)
	Piston ring end gap	Top ring	0.15～0.35mm (0.0059～0.0137in.)	0.7mm(0.0275in.)
		2nd ring	0.15～0.35mm (0.0059～0.0137in.)	0.7mm(0.0275in.)
		Oil ring	0.30～0.90mm (0.0118～0.0354in.)	1.8mm(0.0708in.)
	Piston ring free end gap	Top ring	6.5mm(0.2559in.)	———
		2nd ring	8.5mm(0.3346in.)	———

Item			Standard	Service Limit
Crank shaft	Crankshaft deflection (middle)		———	0.06mm(0.0023in.)
	Crank pin diameter		37.985～38.000mm (1.4954～1.4960in.)	———
	Crank pin clearance in con. rod		0.020～0.040mm (0.0008～0.0016in.)	0.08mm(0.0031in.)
	Connecting rod small end bore		16.003～16.011mm (0.6300～0.6303in.)	———
	Crank journal diameter		49.985～50.000mm (1.9679～1.9685in.)	———
	Bearing-to-journal clearance		0.020～0.040mm (0.0008～0.0016in.)	0.08mm(0.0031in.)
	Crankshaft thrust play		0.130～0.280mm (0.0051～0.0110in.)	0.35mm(0.0138in.)
	Connecting rod big end thrust clearance		0.10～0.20mm (0.0039～0.0078in.)	0.30mm(0.0118in.)
	Connecting rod	Twist	———	0.10mm(0.0039in.)
		Straightness	———	0.05mm(0.0020in.)

CLUTCH &TRANSMISSION

Service Limit			Item	Standard
clutch	Pedal play		15-25mm(0.6～1in.)	———
	Facing wear (Rived head depression)		1.2mm(0.05in.)	0.5mm(0.02in.)
	Facing-input shaft serration backlash		———	0.5mm(0.02in.)
	Clutch release arm play		2～4mm(0.08～0.16in.)	———
Transmission	Clearance between gear's and rings		0.8～1.2mm(0.03～0.05in.)	0.5mm(0.02in.)
	Key slot width of synchronizer ring		9.6mm(0.38in.)	9.9mm(0.39in.)
	Fork shaft locating spring	Free length of No. 1	19.5mm(0.767in.)	17.0mm(0.669in.)
	Rattle of sliding yoke in extension case bush		0.02～0.06mm (0.0008～0.0024in.)	0.1mm(0.0039in.)
	Low&second gear backlash		0.1mm(0.0039in.)	0.3mm
	Third&top gear backlash		0.1mm(0.0039in.)	0.3mm(0.0118in.)
	Reverse gear-reverse idle gear backlash		0.1mm(0.0039in.)	0.3mm(0.0118in.)

LUBRICATION

Item			Standard	Service Limit
Lubrication	Outer gear periphery clearance in pump case		0. 12 ~ 0. 20mm (0. 0047 ~ 0. 0078in.)	0. 3mm(0. 0118in.)
	Outer gear tooth clearance in pump case		0. 25 ~ 0. 40mm (0. 0098 ~ 0. 0157in.)	———
	Inner gear tooth clearance in pump case		0. 60 ~ 0. 80mm (0. 0236 ~ 0. 0315in.)	———
	Oil pump side clearance (flatness)		0. 045~0. 120mm (0. 0018~0. 0047in.)	0. 17mm(0. 0067in.)
	Oil relief valve spring	Free length	60mm(2. 36in.)	———
		10mm(0. 39in.) Compressive force	14. 58N	1LN
	Set pressure-of oil pressure switch		20 ~40kpa	———

COOLING SYSTEM

Service Limit	Item	Standard
Fan belt tension as deflection under 10kg(22lb) push applied to middle point between pulleys	10~15mm(0. 4~0. 6in.)	———
Thermostat start-to-open temperature	82℃(179°F) * 88℃(190°F)	———
Thermostat full-open temperature	95℃(203°F) * 100℃(212°F)	———
Valve lift	8mm(0. 31in.)	———

* For Finnish market

DIFFERENTIAL

Item	Standard	Service Limit
Side gear backlash	0. 05~0. 15mm(0. 002~0. 006in.)	———
Bevel gear backlash	0. 10~0. 20mm (0. 004~0. 0078in.)	———

SUSPENSION

Item		Standard	Service Limit
Strut stroke	Front	121mm(4. 76in.)	———
Shock absorbers stroke	Rear	160mm(6. 30in.)	———
Rear leaf spring (Freeheight)	Amount of bow	120mm(4. 66in.)	———

Item	Standard	Service Limit
Front coil spring free length	268mm(10.55in.)	255mm(10.04in.)
Rear reaf spring free length (Center distance between shackles)	1,000mm(39.37in.)	———

STEERING SYSTEM

Item		Standard	Service Limit
Gear ratio(Gear box)		15.4(0～4°)～17.4(over 26.5°)	———
Steering angle, inside		33°	———
Steering angle, outside		27°	———
Steering wheel diameter		384mm(15.11in.)	———
Minimum turning radius		4.1m(13.45ft.)	———
Starting torque of worm shaft		0.2－0.5N.M	———
Tire inflating pressure (not loaded) (4.50-12-8PR Tires)	Front	29Lbs/in²(200kpa)	———
	Rear	29Lbs/in²(200kpa)	———
Tire inflating pressure (loaded) (4.50-12-8PR Tires)	Front	35Ibs/in²(240kpa)	———
	Rear	54Cbs/in²(375kpa)	———
Toe-in	Vehicle with 4.50-12-8PR	11～15mm(0.433～0.590in.)	———
Camber		1°30′	———
Trail		11mm(0.43in.)	———
Kingpin inclination		12°30′	———
Caster		2°30′	———

BRAKE

Item	Standard	Service Limit
Brake drum inside diameter	220mm(8.66in.)	222mm(8.74in.)
Brake drum"out-of-round"	0mm(0in.)	0.5mm(0.02in.)
Brake lining thickness (lining+shoe ring)	7mm(0.27in.)	3mm(0.12in.)

ELECTRICAL

Item		Standard	Service Limit
Ignition system	Ignition timing	7° B. T. D. C. at 900r/min(rpm)	———
	Ignition order	1-3-4-2	———
	Breaker point gap	0. 4～0. 5mm(0. 016～0. 019in.)	———
	Cam dwell angle	52°	———
	Condenser capacitance	0. 25 microfarad	———
	Ignition coil, Primary winding resistance	About 3 ohm (inclusive of the 1. 5-ohm resistor)	———
	Ignition coil; Secondary winding resistance	About 8 kiloohms	———
Starter	Voltage	12Volts	———
	Output	0. 8KW	———
	Rating	30seconds	———
	Brush length	19mm(0. 75in.)	12mm(0. 47in.)
	Number of pinion teeth	8	———
	Commutator diameter	32. 5mm(1. 28in.)	30. 5mm(1. 20in.)
	Mica undercut	0. 5～0. 8mm(0. 02～0. 03in.)	0. 2mm(0. 007in.)
Charging system	Nominal operating voltage	12Volts	———
	Maximum alternator output	35A	———
	Effective pulley diameter	65mm(2. 56in.)	———
	Maximum permissible alternator speed	13,000r/min(rpm)	———
	Working temperature range	-40～80℃(-104～176°F)	———
	Rotor; Ring-to-ring circuit resistance	4～5ohms	———
	Brush length	16. 5mm(0. 65in.)	11. 0mm(0. 45in.)
	Standard output voltage and current	13. 8～14. 8Volts, 20A minimum	———
	Regulated Voltage	13. 8～14. 8 Volts	———
	Voltage-relay cut in Voltage	4～5. 8Volts	———
	Prescribed cut in Voltage	4～4. 5Volts	———
	Field circuit resistance	6～9ohms	———

20-3. Periodical Inspection Schedule

A machine is in the best operable condition at all times where it is systematically inspected, re-adjusted, re-lubricated and serviced at regular intervals. Such a machine is safe to use and works to the best of its ability. The following schedule has been carefully formulated for the SC1010, with a view to attaining what the above concept implies:

Interval: This interval should be judged by odometer reading or months, whichever comes first										
	km(x1,000)	1	10	20	30	40	50	60	70	80
	miles(x622)	1	6	12	18	24	30	36	42	48
	months	1	6	12	18	24	30	36	42	48
ENGINE										
1. Water pump(fan)drive belt(tension, wear, etc.)		A	-	I	-	R	-	I	-	R
2. Camshaft timing belt(damage, wear)		I	-	I	—	I	-	I	-	I
3. Valve clearance		A	-	A	-	A	-	A	-	A
4. Engine bolts(All cylinder head and manifold fixings)		T	-	T	-	T	-	T	-	T
5. Engine oil filter		R	R	R	R	R	R	R	R	R
6. Engine oil	SAE 20W/40	R	Replace every 10,000km(6,215miles)							
	SAE 20W/40	R	Replace every 5,000km(3,108miles)							
7. Engine coolant		-	-	-	-	R	-	-	-	R
8. Cooling system hoses and connections (leakage, damage, etc)		-	-	I	-	I	-	I	-	I
9. Exhaust pipes and mountings(leakage, damage)		-	-	I	-	I	-	I	-	I
IGNITION										
10. Ignition wiring(damage, deterioration)		-	-	I	-	I	-	I	-	I
11. Distributor cap and rotor(wear, deterioration, etc.)		-	-	I	-	I	-	I	—	I
12. Spark plugs and distributor breaker point		-	R	R	R	R	R	R	R	R
13. Ignition timing		I	A	A	A	A	A	A	A	A
14. Distributor advance		-	-	I	-	I	-	I	-	I
FUEL										
15. Air cleaner	Paved-road	Clean every 10,000Km(6,215miles)								
	Dusty condition	Clean every 2,500Km(1,554miles) or as required. Replace every 40,000Km (24,840miles) More frequent replacement if under dusty driving conditions.								

Interval: This interval should be judged by odometer reading or months, whichever comes first	km(x1,000)	1	10	20	30	40	50	60	70	80
	miles(x622)	1	6	12	18	24	30	36	42	48
	months	1	6	12	18	24	30	36	42	48
16. Cyclone		Clean every month								
17. Accelerator cable&Carburetor shafts		—	I&L	I&L	I&L	I&L	I&L	I&L	I&L	I&L
18. Fuel tank cap, gas lines and connections(leakage, damage)		I	-	-	-	I	-	-	-	I
19. Fuel filter		-	-	-	-	R	-	-	-	R
20. Idle speed and idle mixture		A	-	A	-	A	-	A	-	A
CRANKCASE EMISSION CONTROL										
21. Crankcase ventilation hoses and connections		-	-	I	-	I	-	I	-	I
FUEL EVAPORATIVE CMISSION CONTROL										
22. Fuel vapor storage system, hoses and connections		-	-	I	-	I	-	I	-	I
ELECTRICAL										
23. Wiring harness connections and headlights		-	-	I	-	I	-	I	-	I
CHASSIS AND BODY										
24. Clutch pedal(play)		I	I	I	I	I	I	I	I	I
25. Brake fluid(level, leakage)		I	I	I	I	R	I	I	I	R
26. Brake pedal(travel)		I	I	I	I	I	I	I	I	I
27. Brake lever and cable(play, damage)		I	I	I	I	I	I	I	I	I
28. Brake drums and shoes(wear)-		I	I	I	I	I	I	I	I	
29. Brake hoses and pipes(leakage, damage)		-	I	I	I	I	I	I	I	I
30. Tires(abnormal wear and pressure, etc)		-	I	I	I	I	I	I	I	I
31. Wheels and hub nuts(damage, tightness)		I	I	I	I	I	I	I	I	I
32. Shock absorbers(oil leakage, damage)		-	I	I	I	I	I	I	I	I
33. Propeller shaft(tightness, damage)		-	-	I	-	I	-	I	-	I
34. Transmission and differential oil(level, leakage)		R	I	I	I	R	I	I	I	R
35. Bolts and nuts(tightness)		T	-	T	-	T	-	T	-	T
36. Steering condition(play, tightness, leakage, etc.)		I	I	I	I	I	I	I	I	I
37. Test drive		Test drive on completion of each service								

"A": Check and/or adjust if necessary
"R": Replace or Change
"I": Inspect and correct or replace if necessary
"T": Tighten to the specified torque
"L": Lubricate "C": Clean

NOTE:
The item 16 is applicable to vehicles mounted cyclone.