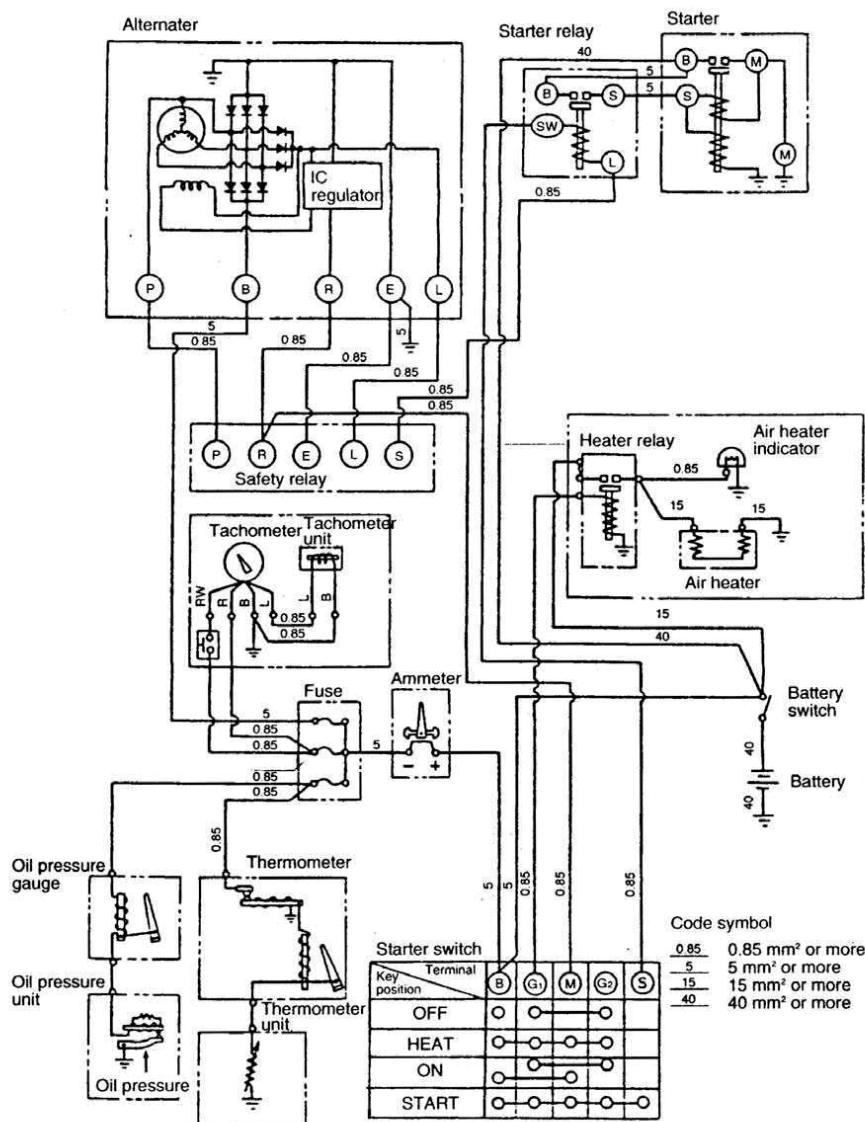


1.GENERAL

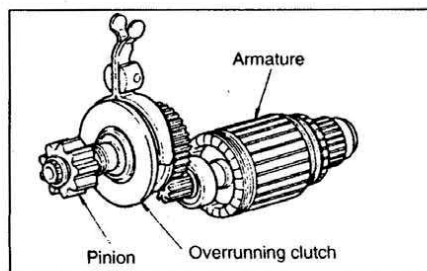
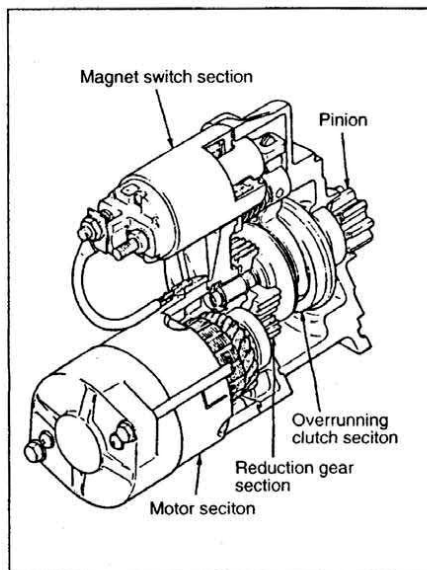
<24V type>



1-1 Starter

The strater is an overhang type in which the pinion sliding surface are not exposed to the outside.

Major components include: the motor that develops a high torque required to get the engine started; overrunning clutch that transmits torque and prevents the starter from overrunning; magnetic switch that brings the pinion into mesh with the ring gear, while turning on/off the load current to the motor; and, the reduction gear which boosts the armature torque.

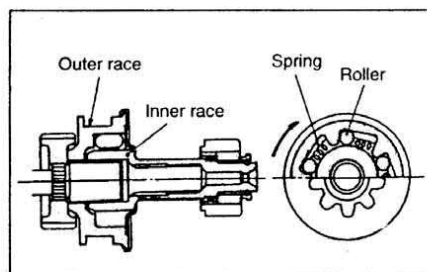


(2) Overrunning Clutch

A roller-type overrunning clutch is used.

Rollers are housed in the wedgeshaped grooves formed by the outer and inner races (sleeve) and pressed by springs.

When the starter is started, the roller is pressed towards the narrower side of the groove, functioning as a key to transmit rotation of the outer race to the pinion. No torque is transmitted, however, from the pinion (as it is turned by the engine), as the roller compresses the spring moving toward the wider side of groove and releasing the key action.



(3) Operation

While the starter switch is ON, current flows from the terminal "SW" of the starter relay to the terminal "L" and closes the contact P_2 .

When the contact P_2 closes, current from the battery flows from the terminal "S" to the magnetic switch to the pull-in coil (P) and holding coil (H). Furthermore, the current that has decreased flows from the terminal "M" to the motor section.

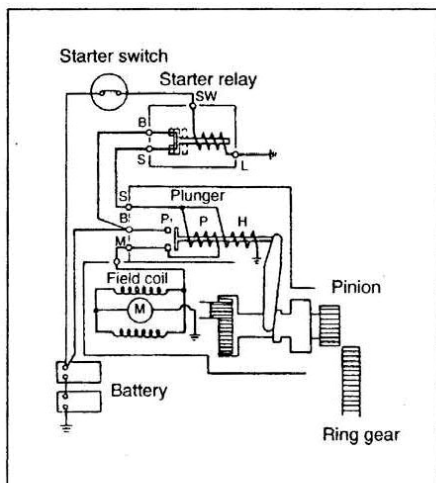
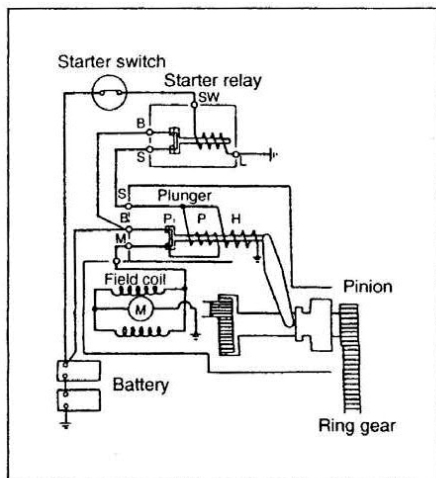
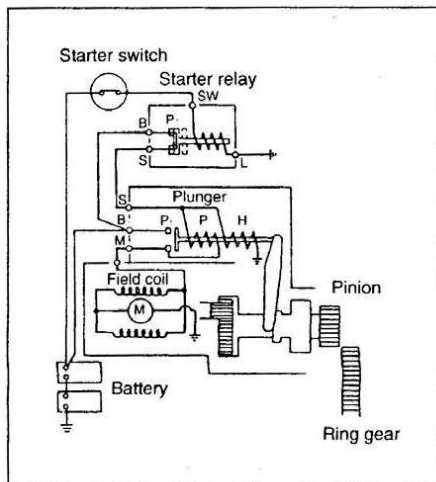
The plunger, attracted by the magnetic flux of the pull-in coil and holding coil, closes the contact P_1 and simultaneously pushes out the pinion turning slowly on weak current.

When the pinion comes into complete mesh with the ring gear, the contact P_1 closes and the large current of the battery directly flows to the motor section to turn the pinion powerfully.

In this condition, no current flows to the pull-in coil. The plunger is retained by the holding coil alone.

When the starter switch is placed to OFF, current to the holding coil (H) is interrupted. The plunger is returned to its original position by the return spring and the contact P_1 opens so that current to the motor section is interrupted.

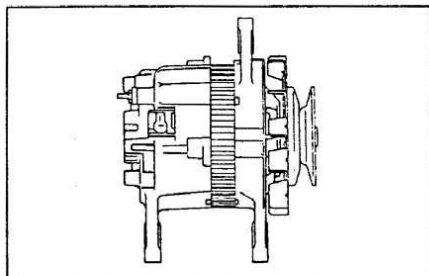
The moment the starter switch is opened, the battery current flows from the terminal "B" to the pull-in coil (P) and holding coil (H). Since the coils are wound in opposite direction to each other, the magnetic fluxes cancel each other so that the return spring can move the plunger back to its original position.



1-2 Alternator

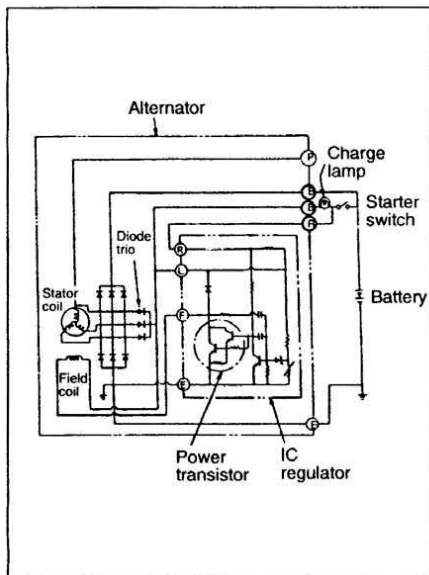
The alternator with a built-in IC Regulator (abbreviated to the built-in alternator) is used.

The alternator consists of the IC regulator and brush holder accommodated in the rear bracket.



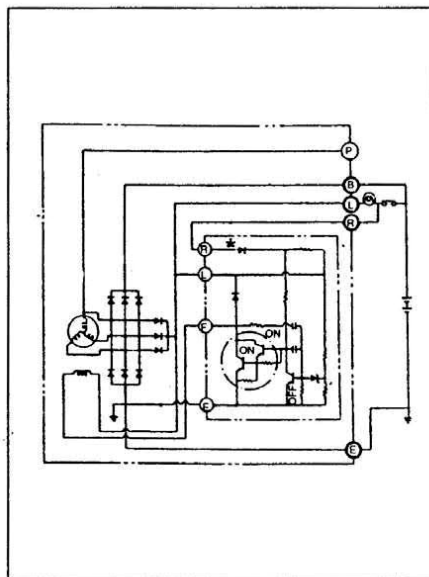
a) Features of the Built-in Alternator

- (1) For better voltage buildup especially at idle speeds, the alternator is provided with the R terminal independent from the L terminal (charge lamp circuit) as the initial excitation circuit.
- (2) The three diodes (diode trio) built into the alternator apply the field current directly to the field coil, eliminating voltage drop caused by the starter switch and wiring.
- (3) The P terminal is for detecting the safety frequency.



b) Operation

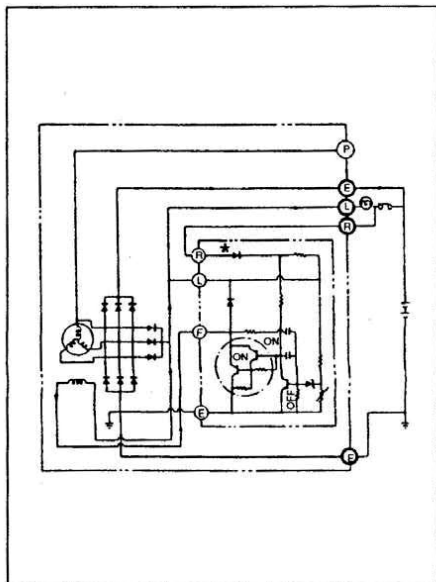
When the starter switch is turned ON, base current flows from the battery to power transistor to turn it ON, allowing the current to flow through the field coil to turn on the charge lamp.



As the engine starts with the alternator generating power, the base current is supplied by the alternator itself.

The field current also flows from the diode trio to energize the rotor.

At the time the charge lamp goes off, since the output voltage from the B terminal becomes the same as that from the L terminal.



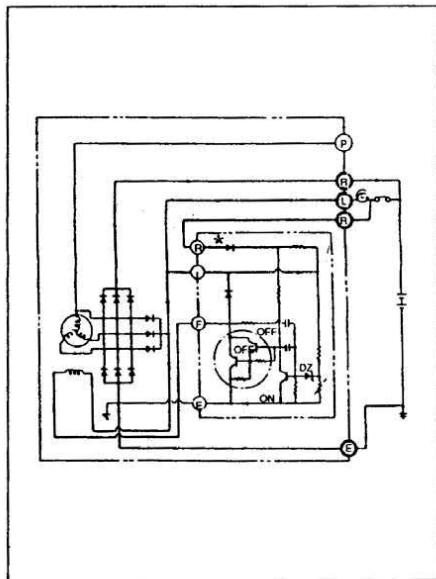
As the voltage developed by the alternator builds up, the zener diode Dz conducts providing base current for the transistor Tr1 to turn it ON.

As a result, the base current of the power transistor is shorted to Tr1, which turns OFF the power transistor.

This means that there is no field current flow, dropping the voltage generated by the alternator.

When the zener diode Dz is shut off with a voltage drop, the base current flows to the power transistor to turn it ON. As a result, the field current again starts flowing, increasing the generated voltage.

These IC regulator operations repeat to regulate the alternator voltage.



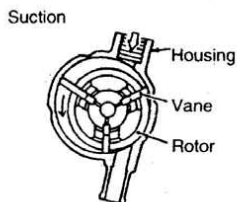
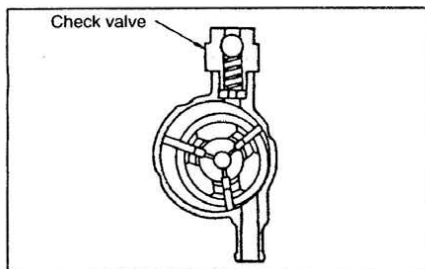
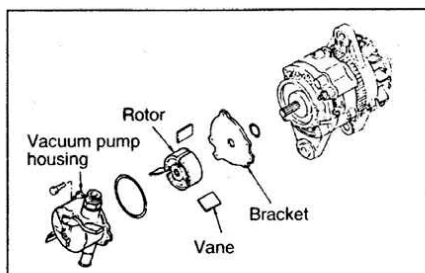
1-3 Vacuum Pump

The vacuum pump is of a rotary type with movable vanes.

The rotor with three movable vanes turns in the housing of a cylindrical shape. The housing is mounted on the rear bracket of the alternator with the rotor spline-coupled into the alternator shaft.

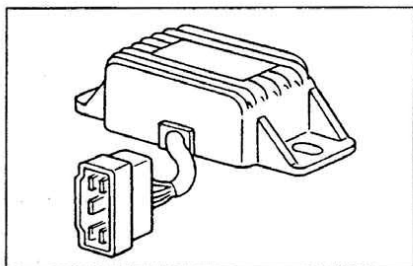
The rotor and housing are eccentric. The air drawn in through the suction port is gradually compressed and discharged from the deliver port. Oil is also drawn in through the oil filler port to provide sealing, lubricating, and cooling functions for the housing, and discharged from the deliver port with the compressed air to the oil pan.

The check valve prevents the engine oil and compressed air from flowing back to the vacuum tank when the engine is stationary.

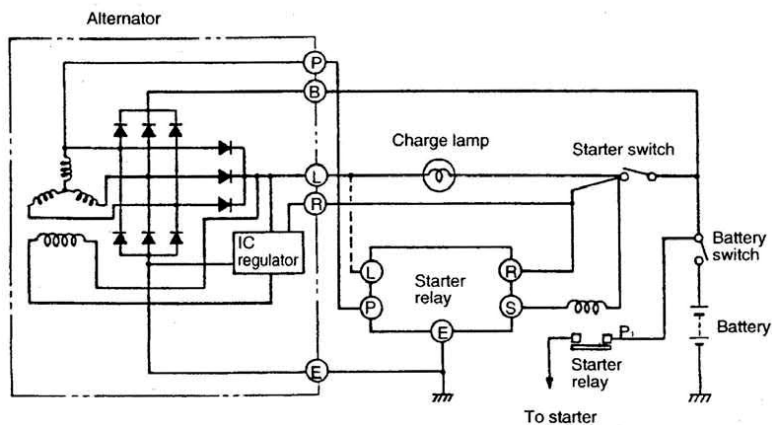


1-4 Safety Relay

The alternator rpm is detected and when it exceeds the reference level, the safety relay prevents the starter from operating even if its switch is accidentally turned on during engine revolution.



Operation



- (1) When the starter switch is set to ON, current flow from the starter relay to terminal "s" and to terminal "E" of the safety relay, closing contact P₁. The charge lamp also illuminates if provided.
- (2) As the starter runs and the engine starts running, pluses of frequency 1/10th of the alternator speed appear at terminal "P" of the alternator.
The charge lamp goes out.
- (3) When the pulse frequency at terminal "P" exceeds the specified value, continuity between terminals "S" and "E" is lost. Then, the starter does not operate even if the starter switch is set to ON while the engine is running.

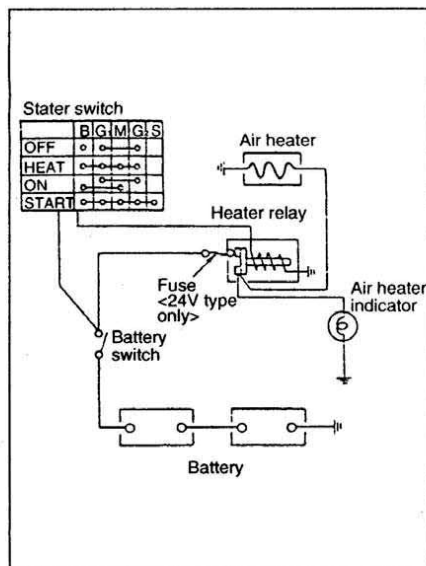
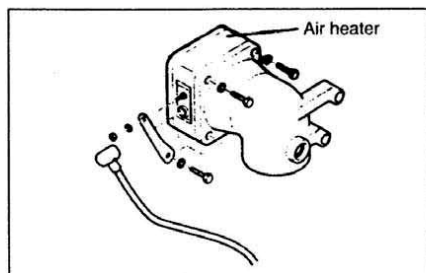
1-5 Preheater

(1) Intake Air Heater<D4A>

The intake air heater which is electric type heats intake air in the inlet manifold to facilitate engine startup in cold weather.

Set the starter switch to HEAT to energize the intake air heater mounted on the inlet manifold. The heater becomes red heated and in about 20 to 30 seconds, its temperature reaches 800℃ or higher. Then, the it heater indicator comes on to indicates heat state to the driver.

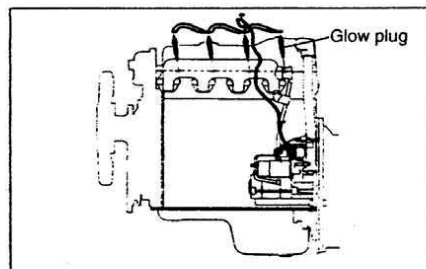
The heater relay has a fuse to prevent overcurrent from flowing to the intake air geater circuit.



(2) Glow plug sys (D4DA, D4AF Fork Lift)

The glow plug heats the switch chamber to easily start the engine in cold weather.

The glow plug, of a sheathed type, is connected in parallel.



Combustion chamber
Water temp gauge unit

Glow plug

Battery

To starter relay

F7

F3

Indicator lamp

Water sensor

Lamp timer

Lamp timer

Lamp timer

Relay

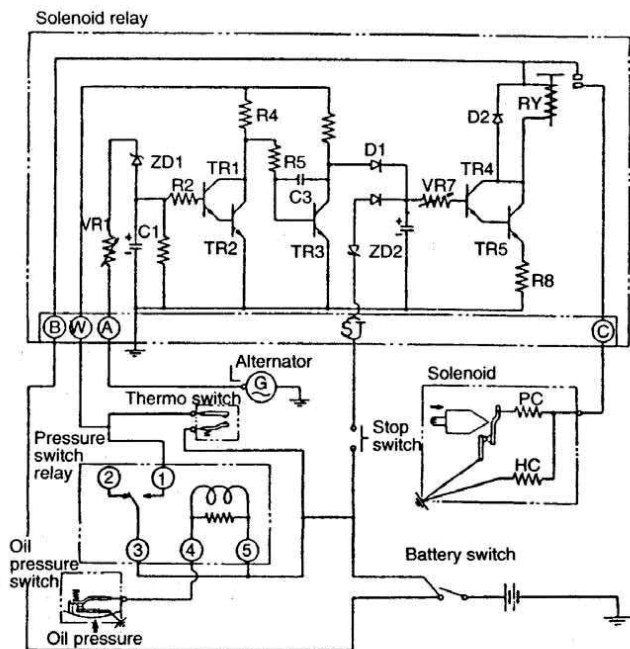
	B	ACC	M	S
LOCK				
ACC	☐	☐		
ON	☐	☐	☐	
START	☐	☐	☐	☐

Stater switch

1-6 Automatic Stop Device

If the coolant temperature rises or the oil pressure falls while the engine is running, this device operates the stop lever of the injection pump governor to cut fuel supply and automatically stops the engine.

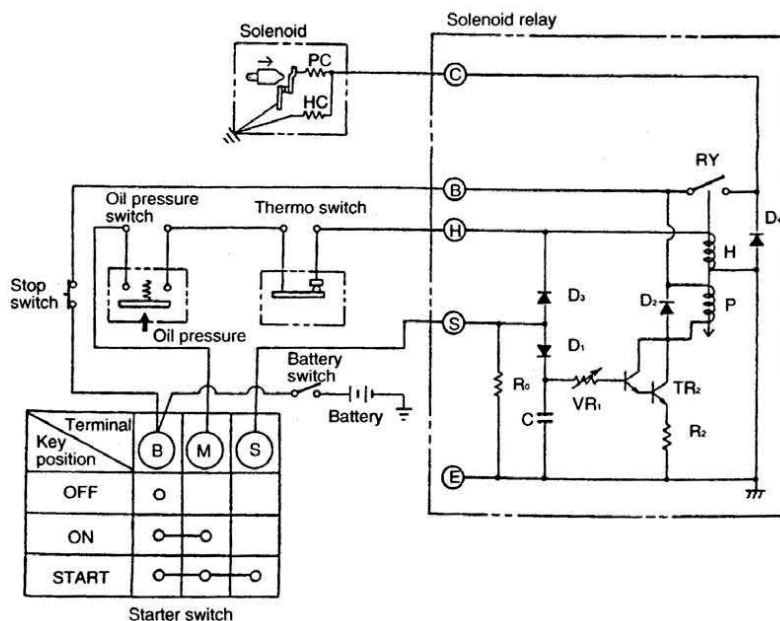
(1) Run Off Type



(a) Start circuit

- 1) current flows from the solenoid relay (B) to the RY coil and applies the voltage to the collectors of TR₄ and TR₅ but RY does not operate, as there is no input to the base.
- 2) Current also flows from the oil pressure switch to the solenoid relay (W) to R₄ to R₅ and applies the voltage to the base of TR₃, when the voltage is applied to the base of TR₃ current flow from R₆ to C and E of TR₃ to the ground, and RY does not operate, as there is no input to TR₄ and TR₅ of the stop circuit.

(2) Run On Type<24V Type>



(a) Start circuit

- 1) When the battery switch is turned ON:

Solenoid relay (B) → RY pull-in coil P → TR₁ collector
 TR₂ collector

RY contacts do not operate with no input to the base of TR₁ and TR₂.

- 2) When the starter switch is placed in the START position:

Starter switch S → Solenoid relay (S) → Resistor R₀ → Ground

Diode D₃ → RY holding coil H → Ground
 Diode D₁ → Capacitor C

When the capacitor C is charged, voltage is applied from VR₁ to the base of TR₁ actuating TR₁.

As voltage is applied to TR₁ collector, TR₁ emitter, and to TR₂ base, a current flows from TR₂ collector to TR₂ emitter, resistor TR₂, and ground, causing the RY pull-in coil P to close the RY contacts.

3) When the RY contacts turn ON:

Current flows from solenoid relay (B) to RY, solenoid relay (C), and the solenoid, activating the solenoid and starting the engine.

4) As the engine starts and starter switch is placed in the ON position, voltage to the solenoid relay (S) is cut off; however, TR₁ and TR₂ stay ON for approximately another 30 seconds by the discharge current of the capacitor C. During capacitor C's discharging, the oil pressure builds up as the engine speed increases, causing the oil pressure switch to turn ON. This causes the current to flow from the starter switch (M) to oil pressure switch, thermo switch, solenoid relay (H), RY holding coil H, and to ground, keeping the RY contacts in ON state.

(b) Automatic stop circuit

When the thermo switch and oil pressure switch detect an abnormal condition, each switch turns OFF and the RY contacts open, deactivating the solenoid and stopping the engine.

(C) Pushbutton stop

To stop the engine during operation, operate the stop switch, and the stop operation is performed just as when the automatic stop is performed.

2. SPECIFICATIONS

Description	Specification		
Model	D4A / D4AF(Fork Lift)	D4DA	
		Fork Lift	Generator
Voltage-Polarity	(-) earth	←	
Starter type	Overhang electro-magnetic push-in type reduction starter	←	
Starter output	24V-5Kw / 12V-3.2Kw	12V-3.2Kw	
Alternator type	Alternator with built-in Ic regulator (Idle-speed efficient type)	←	
Alternator output	24V-25A/12V-90A	12V-90A	24V-40A
Vacuum pump type	Rotary pump with 3 vanes, directly coupled with alternator	-	
Preheater system	Air heater / Glow plug system	←	
Glow plug temperature(30sec)	-	1050 ± 80℃	
Glow plug voltage(30sec)	-	3A	
Air heater capacity	2.0Kw	-	
Relay fuse capacity	95A	-	

3. SERVICE STANDARDS

3-1 Service Standard Table

Unit : mm

ProCarManuals.com

Description				Nominal value [Basic diameter]	Limit	Correction and remarks
Starter	Commutator O.D.			32	31	Replace
	Commutator runout on periphery				0.05 or more	Correct or replace
	Mica depth of grooves between segment				0.2 or less	Correct
	Brush length			18	11	Replace
	Brush spring tension			25 to 34 N (2.55~3.45 kg)	20N(2kg)	Replace
	Pinion shaft thrust gap			0.1 ~ 0.5		Adjust with washer
	Pinion gap			0.5 ~ 2.0		Adjust with packing
	No-load	Voltage	24V type	23V		Check
	Character- istics	Current		80A or less		
		Speed		3,400 rpm or more		
Magnet switch operating voltage		24V type	16V or less			
Alter- nator	25A type	Slip ring O.D.		32.8~33.2	32.4	Replace
		Brush spring tension		3 to 4.2N (0.31~0.43kg)	2.1 N (0.21 kgf)	Replace
		Brush length		18.5	7	Replace
		Field coil resistance(20)		Approx. 10 Ω		Replace
		Load character- istics (When cold)	Terminal Voltage	27V		Check
			Current	22A or more		
			Rotating speed	2,500 rpm		

ProCarManuals.com

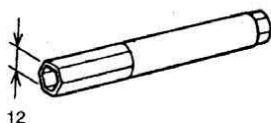
Description				Nominal value [Basic diameter]	Limit	Correction and remarks	
Alter- nator	25A type	Ic regulator regulated voltage rang(5,000 rpm, 5A or less)		28 to 29V		Check	
Vacuum Pump	60cc type	Maximum at- tainable vacuum	Vacuum	91 kPa(680 mmHg) or more		Check. Oil supply pressure(at 3,000 rpm): 295 to 345 kPa (3 to 3.5 kgf/cm ²)	
			Rotating speed	3,000 rpm			
		Deliver char- acteristic after 20 seconds with a 10 lit tank load	At low speed	Vacuum	67 kPa (500 mmHg) or more		
				Rotating speed	1,500 rpm		
			At high speed	Vacuum	77 kPa (580 mmHg) or more		
				Rotating speed	3,500 rpm		
*Quick- heating air heater	Heat indicator lamp on time	Coolant temperature -5℃		6 seconds		Check	
		Coolant temperature -15℃		10 seconds			
		Coolant temperature -20℃		20 seconds			
	Preheating time	Coolant temperature -5℃		14 seconds			
		Coolant temperature -15℃		18 seconds			
		Coolant temperature -20℃		28 seconds			
	Afterheating time	Coolant temperature -5℃ to 10℃		10 seconds			
		Coolant temperature -5℃ or less		30 seconds			

Description			Nominal value [Basic diameter]	Limit	Correction and remarks
Glow plug	Time required for indicator to become red hot		15 to 35 seconds		Check
	Resistance under normal temperature	24V type	3.08 to 3.75 Ω		Replace
		12V type	1.14 to 1.39 Ω		

3.2 TIGHTENING TORQUE TABLE

Description	Thread size O.D. $\times$ pitch mm	Tightening torque (kgf m)	Remarks
Alternator pulley nut	M17 $\times$ 1.5	83 to 105(8.5 to 11)	
Alternator bolt	M12 $\times$ 1.25	91(9.3)	
Alternator adjusting bolt	M12 $\times$ 1.25	82(8.4)	
Glow plug	M12 $\times$ 1.25	20(2)	

4. SPECIAL TOOLS

Tool name	Part number	Shape (Unit : mm)	Use
Socket	31391-12400 (D4DA)	 The diagram shows a cylindrical socket tool with a hexagonal base. A dimension line indicates the depth of the socket is 12 mm.	Removal and installation of glow plug

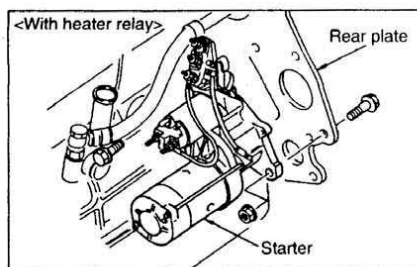
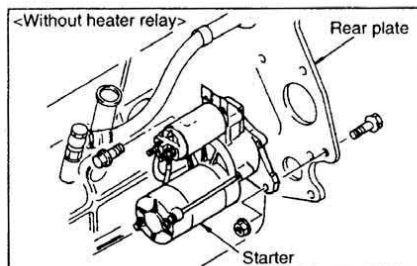
5. SERVICE PROCEDURES

Whenever removing electrical parts from the engine, be sure to place the starter switch in OFF position and disconnect the negative battery cable from the frame.

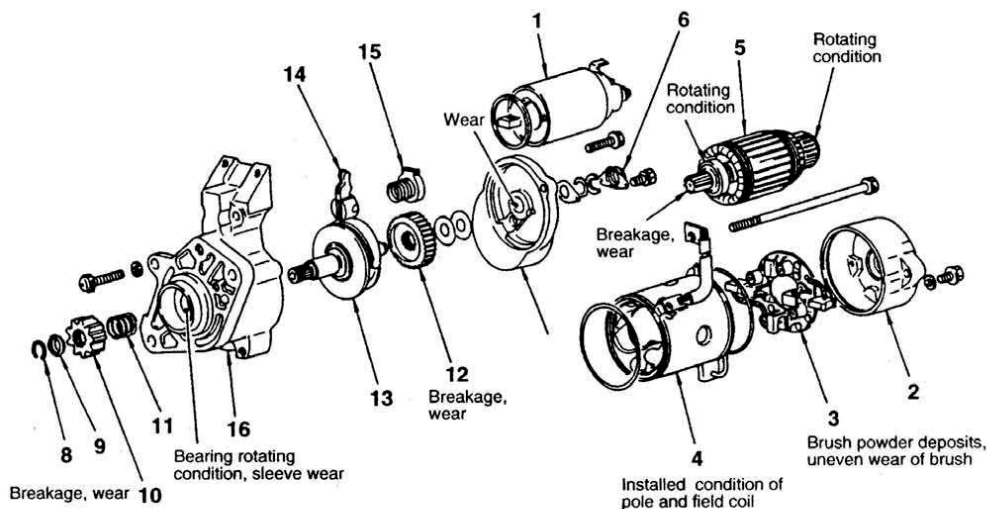
5.1 STARTER

5.1.1 Removal and Installation

Remove the starter from the rear plate and FLY wheel housing.



5.1.2 Disassembly



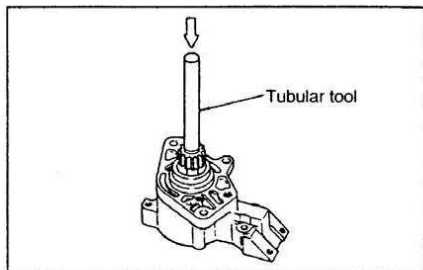
<Disassembly sequence>

- 1 Magnetic switch
- 2 Rear bracket
- 3 Brush holder
- 4 Yoke
- 5 Armature
- 6 Cover
- 7 Center bracket
- 8 Ring

- ⑨ Pinion stopper
- 10 Pinion
- 11 Spring
- 12 Gear
- 13 Pinion shaft
- ⑭ Lever assembly
- 15 Spring set
- 16 Front bracket

For disassembly of parts with an encircled number, see following pages.

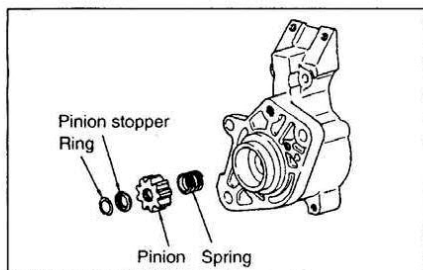
- (1) Do not remove the bearings on both ends of the armature unless defective.



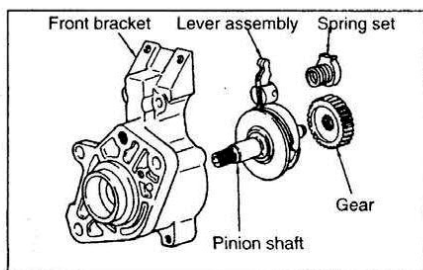
- (2) Apply a tubular tool to the pinion stopper and tap it with a hammer until the pinion stopper comes off position to the clutch side.

NOTE:

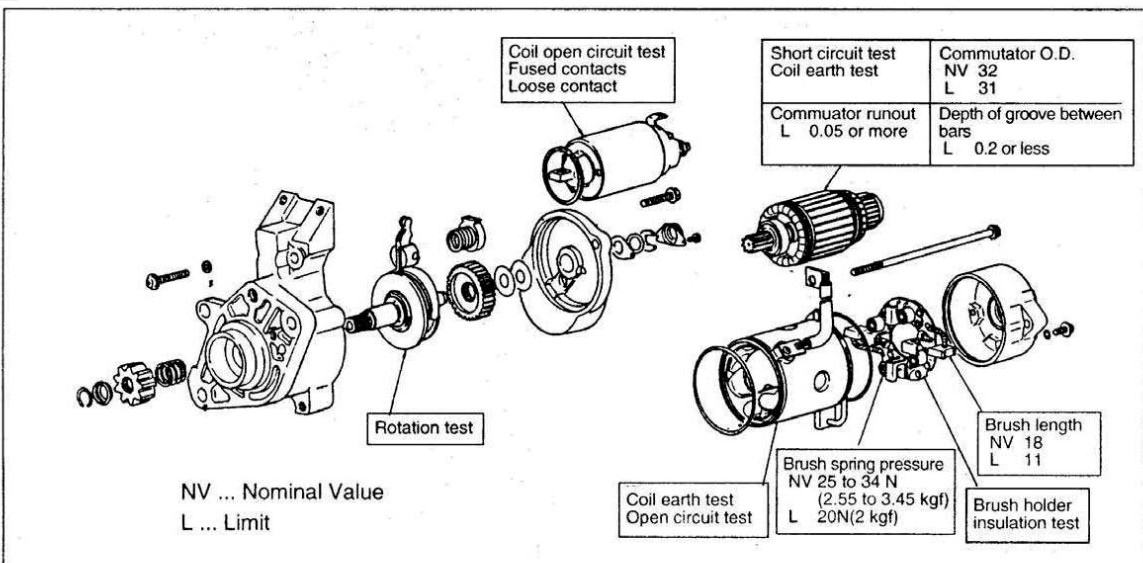
If the pinion stopper cannot be removed, deburr the groove in the pinion shaft.



- (3) Note the installed direction of the level to avoid wrong reassembly.



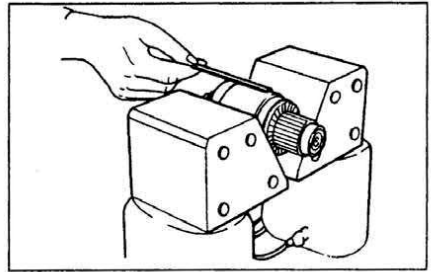
8.1.3 Inspection and Correction



(1) Armature

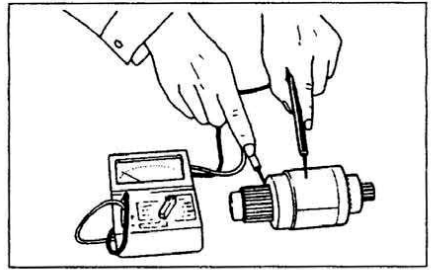
(a) Coil Short Circuit Test

Place the armature on a growler tester. Hold a piece of iron in parallel with the armature and slowly turn armature by hand. If the iron piece is attracted or vibrates, it means there is a short circuit. Replace the armature.



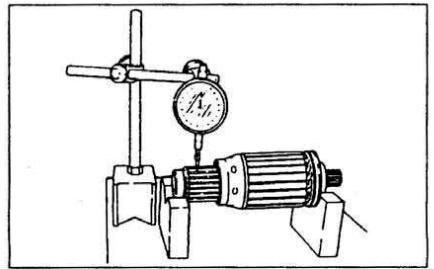
(b) Coil earth test

Check for continuity across the commutator and shaft (or core). If there is a continuity, indicating that the coil is earthed, replace the armature.

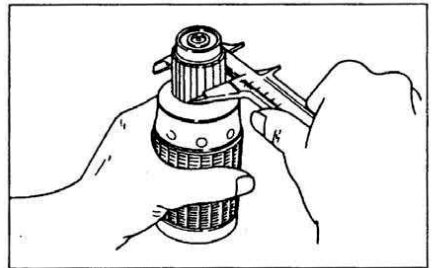


(c) Commutator check

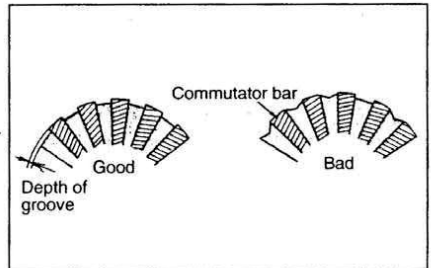
Measure the runout of commutator with a dial gauge. If the runout exceeds the limit, correct, ensuring that the O.D limit is not exceeded. If the commutator surface is rough developing ridge wear, correct with sandpaper (NO. 300 to 500).



(d) Measure the commutator O.D If the measurement exceeds the limit, replace the armature.



(e) Measure the depth of groove between bars. If it does not reach the limit, correct.

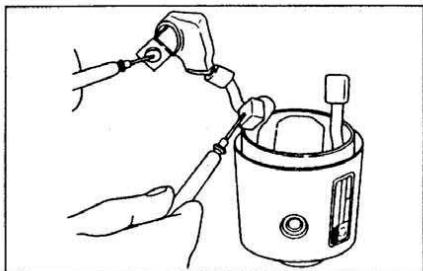


(2) Field coil

(a) Coil open circuit test

Check to ensure that there is continuity between the terminal lead and brush (+).

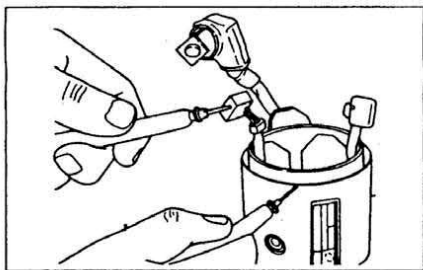
If there is continuity indicating an open circuit, replace the yoke assembly.



(b) Coil earth test

Check to ensure that there is no continuity between the yoke and brush(+).

If there is continuity indicating that the coil is earthed, check for poor insulation. If repair is impossible, replace the yoke assembly.



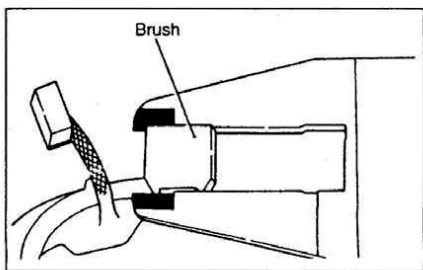
(3) Brush and brush Holder

(a) Brush Wear

Measure the brush length and, if the measurement is less than the limit, replace the brush.

If the brush is unevenly worn or develops rough surfaces, correct with sandpaper (NO. 300 to 500).

NOTE: Correct the brush contact surface to a curve of the commutator.

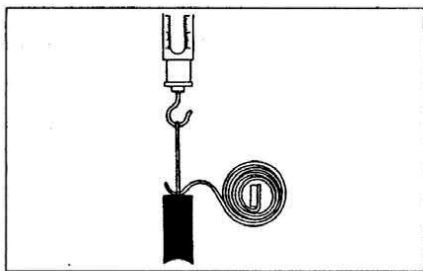


(b) Brush spring pressure

Measure the installed load of the brush spring.

Using a new brush, read the load at the moment the spring leaves the brush.

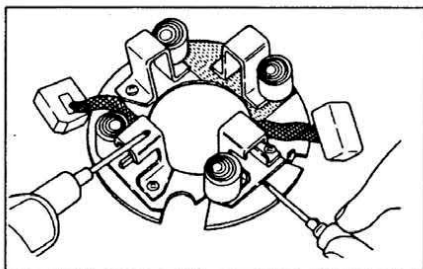
If the spring pressure is below the limit, replace the spring.



(c) Brush holder Insulation test

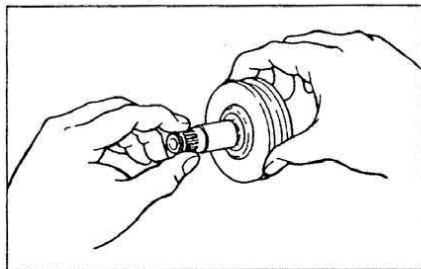
Check to ensure that there is no continuity between the (+) brush holder and (-) holder plate.

If there is continuity, replace the brush holder.



(4) Overrunning clutch

Check to ensure that the pinion shaft turns smoothly when turned in the drive direction (clockwise) and locks when turned in the opposite direction (counter clockwise). If the pinion shaft does not properly rotate, replace the overrunning clutch.



(5) Magnetic Switch

Perform the following continuity tests and, if any faulty condition is evident, replace the magnetic switch.

(a) Coil open circuit test

Check to ensure that there is a continuity across SM terminals, and S terminal and ground.

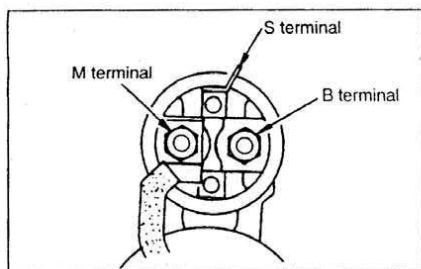
(b) Fused Contact Check

Check to ensure that there is no continuity across and M terminals.

(c) Loose Contact test

Check to ensure that voltage drop across contacts small.

If a large voltage drop involves, it means that contacts are defective.



(6) Replacement of Front Bearing

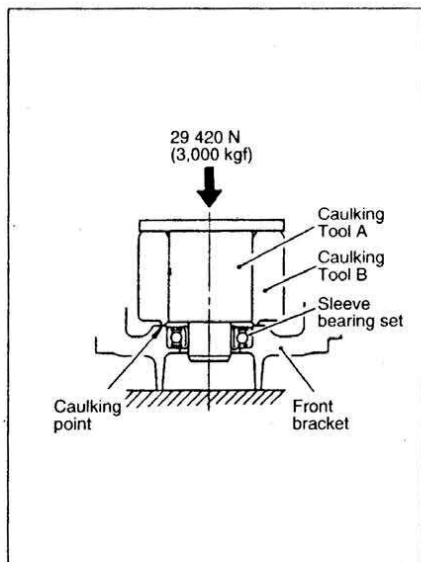
If the front bearing is defective, replace it by the following procedure.

Bearing replacement procedure

After replacing the bearing, use Caulking Tools A and B (special tools) to caulk the bearing two times. (Since one caulking operation can provide caulking at four points, two caulking operations will provide caulking at eight points.)

A caulking load of 29 420 N (3000 kgf) (static load) is applied.

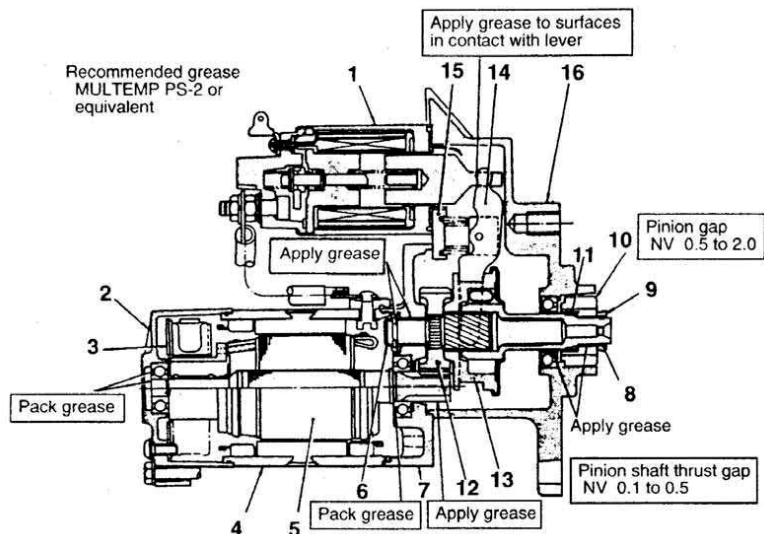
After caulking, make sure that the bearing turns lightly.



NOTE:

Bearing replacement by the abovementioned procedure shall be made only once.

5.1.4 Reassembly



NV ... Nominal Value

<Assembly sequence>

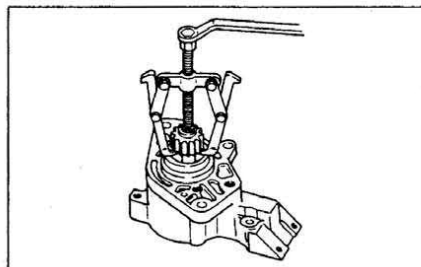
16→15→14→⑬→12→11→⑩→9→8→7→⑥→⑤→④→③→②→①

For Reassembly of parts with an encircled number, see following pages.

NOTE:

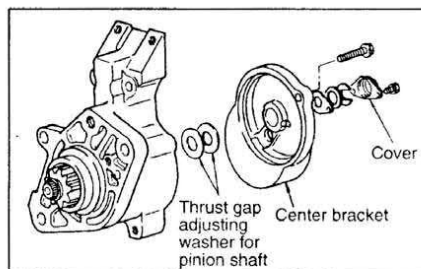
Ensure Correct installation direction for the lever assembly.

- 4.) To install the pinion, pass the pinion shaft through front bracket. Then, with the spring, pinion, and pinion stopper mounted and the ring fixed to the pinion shaft groove, pull the pinion or pinion stopper toward ring to fix in position.



(2) Adjustment of pinion Shaft Thrust Gap

Measure the thrust gap with the following procedure and, if the measurement is of specification, adjust by using adjusting washers.



(a) With pinion Removed

Mount the gear onto the pinion shaft and pass the shaft through the center bracket.

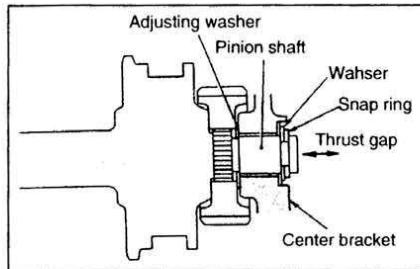
Then, secure the pinion shaft with a washer and snap ring.

Now, move the pinion shaft in the axial direction to measure the thrust gap.

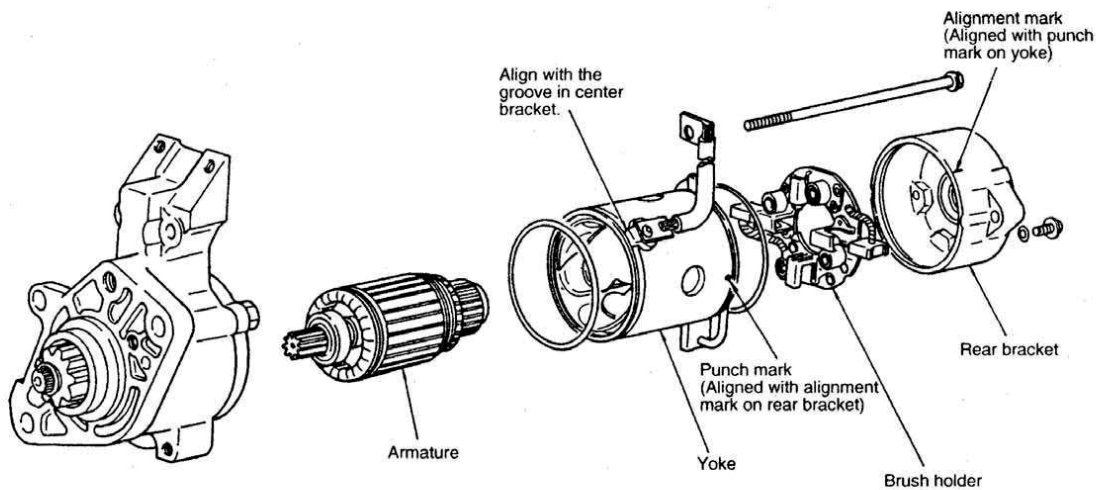
(b) With Pinion Mounted

Temporarily secure the pinion shaft and gear between the front and center bracket with attach bolts. Then, adjust the thrust gap by moving pinion shaft in the axial direction.

At the time, lead the spring set removed: the spring set, when installed can cause the center bracket to rise resulting incorrect measurement of the thrust gap.



ProCarManuals.com (c) Assemble by lining up alignment marks.

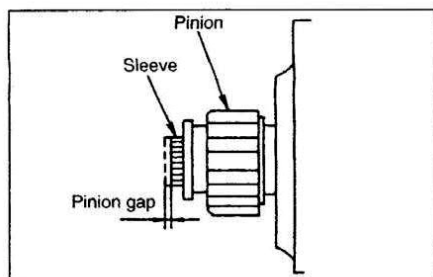
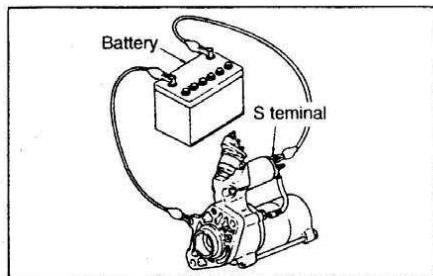


5.1.5 Adjustment and Test after reassembly

(1) Adjustment of pinion Gap

When the reassembled starter is wired as shown, the pinion comes out rotating. When the M terminal is disconnected, the pinion stops rotating, being held in the out position.

Then, push the sleeve lightly back and measure the backward travel (movement), which is the pinion gap. Adjust by varying the number of packings in the magnetic switch to obtain the nominal value for the gap. To reduce the pinion gap, use a greater number of packings.



(2) Test

Set up a circuit as shown check for no characteristics.

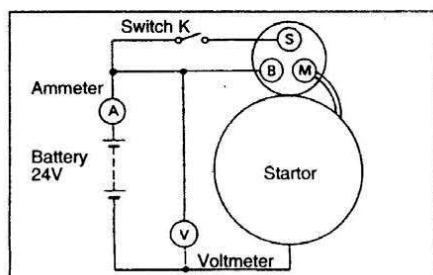
<24 V type unit>

No-load characteristics	Voltage	23 V
	Current	80 A or less
	Rotating speed	3 400 rpm or more

<12 V type unit>

No-load characteristics	Voltage	11 V
	Current	130 A or less
	Rotating speed	4 000 rpm or more

Magnetic switch operating voltage	16 V or less
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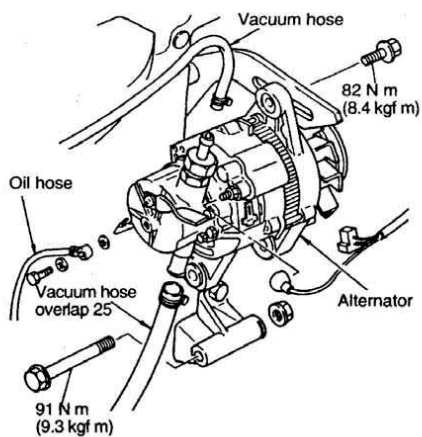
NOTE:

1. Use wires as thick as possible tighten all terminals securely.
2. The reduction gear built into the starter produces high rotating sound at load.
3. If the starter is operated for a long period, the battery will run down resulting in reduced rotating speed. Do not operate the starter for more than 10 to 15 seconds at one time.

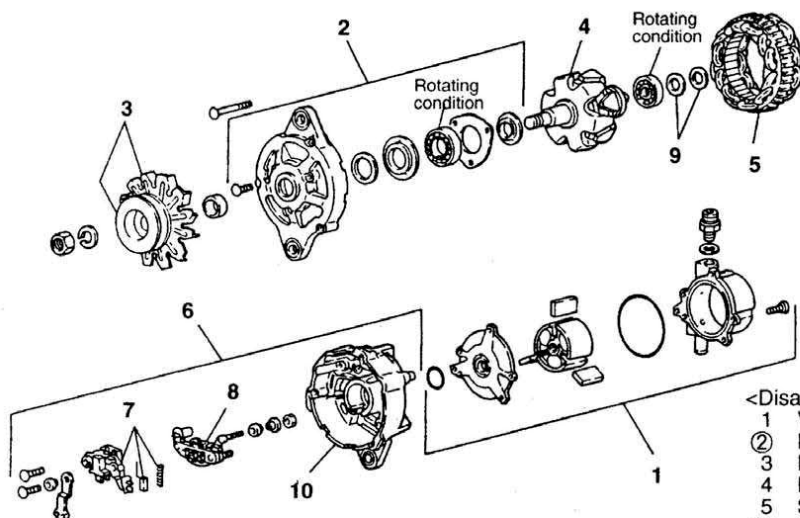
5.2 ALTERNATOR

5.2.1 Removal and Installation

Remove the alternator, oil hose, vacuum hose, and other parts.



5.2.2 Disassembly

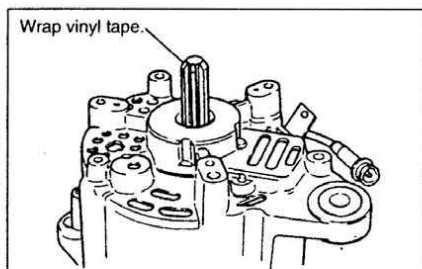


<Disassembly sequence>

- 1 Vacuum pump assembly
- ② Front bracket
- 3 Pulley and fan
- 4 Rotor
- 5 Stator
- ⑥ Rear bracket assembly
- 7 Regulator assembly
- 8 Rectifier assembly
- 9 Oil seal
- 10 Rear bracket

For disassembly of parts with an encircled number, see following pages.

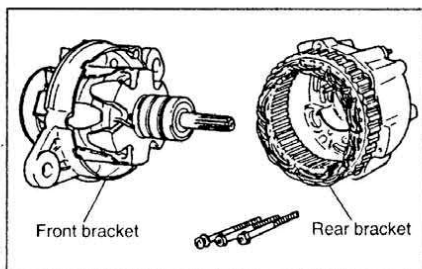
- (1) Remove the vacuum pump.



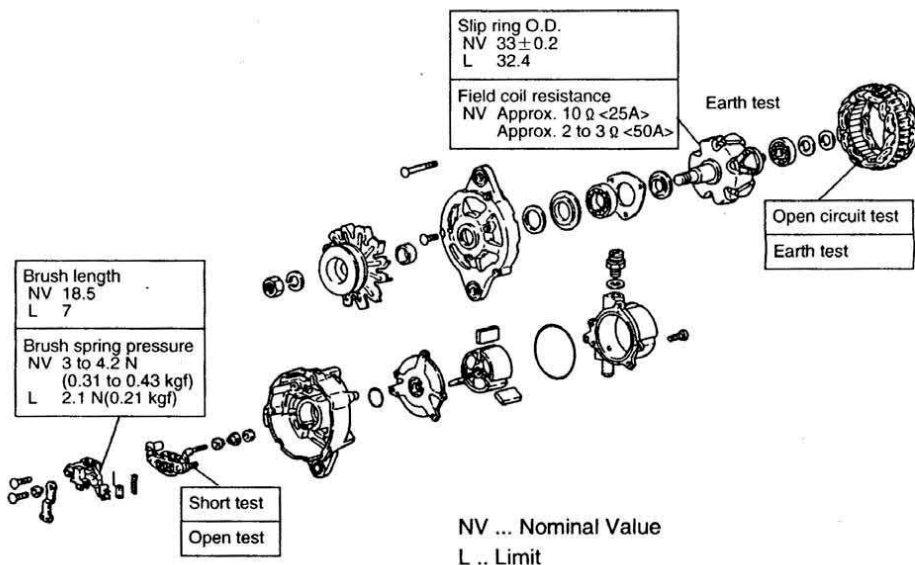
- (2) When disconnecting the front from rear bracket wrap vinyl tape around the shaft splines to prevent damage to oil seal lips.

NOTE:

Use care not to lose the spring installed in the outer periphery of the bearing on the rear end.

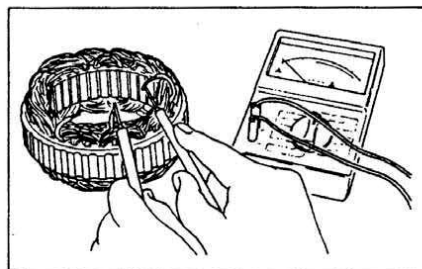


5.2.3 Inspection and Correction



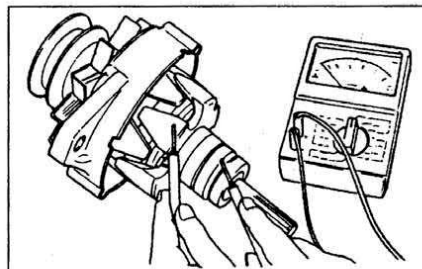
(1) Stator

Check that there is continuity across the stator leads. If there is no continuity indicating a broken wire, replace the stator. Check that there is no continuity across the stator leads and core. If there is, replace the stator as it is earthed.

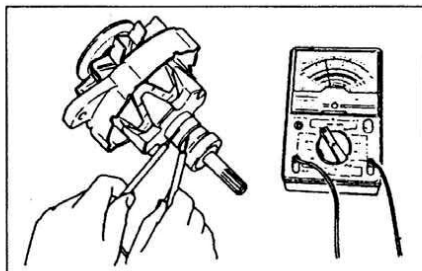


(2) Rotor

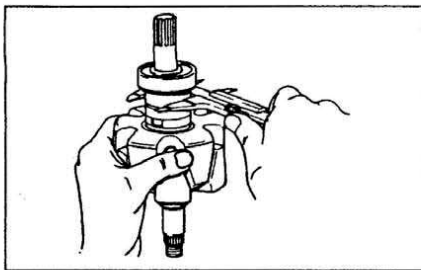
- (a) Check that there is no continuity between the slip ring and core. If there is, replace the rotor.



- (b) Measure the resistance across slip rings. Replace the rotor if the resistance is not within the specification.

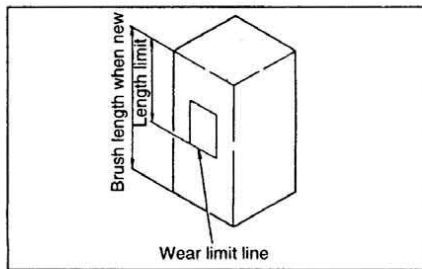


- (c) If the slip ring has rough surface or is unevenly worn, correct with sandpaper or lathe. Correction must be made within the limit of slip ring O.D.

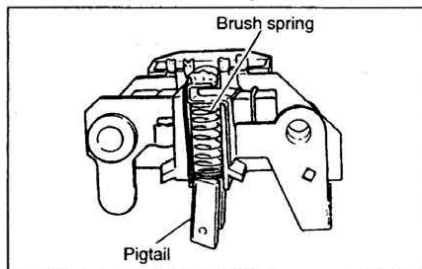


(3) Brush

- (a) Replace the brush if it is worn beyond the limit.



- (b) When a brush has been replaced with a new one, push it in to measure the brush spring pressure. If the spring pressure is lower than the limit, replace the brush spring.

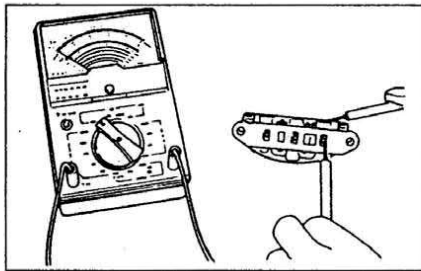


- (c) Replacement of Brush and Brush Spring.

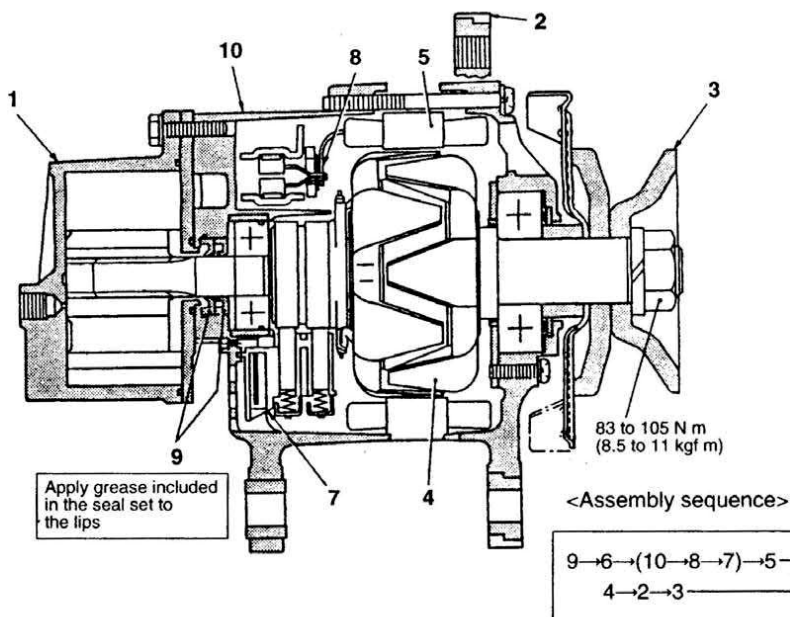
The brush and brush spring can be removed by unsoldering the pigtail.

(4) Diode

- (a) For each diode, check the resistance across of leads and heat sink.
(b) Make the check in two modes, by connecting positive (+) lead of multimeter to the diode and negative (-) lead to the diode.
(c) The diode is open if the resistance is infinite in both cases.
(d) It is shorted if the resistance is almost 0 in both cases. Replace the rectifier if the diode is open or shorted. For the diode trio, check resistance across leads.



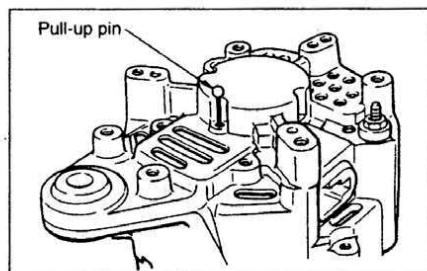
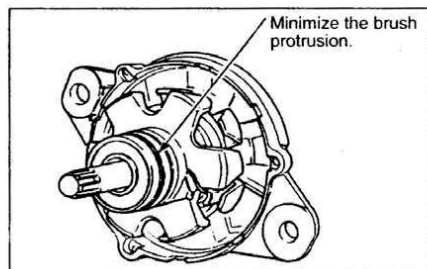
5.2.4 reassembly



When installing the lock spring into the eccentric groove in the outer periphery the rear bearing, ensure that the maximum protrusion rests in the deepest parts.

NOTE:

1. When installing a new bearing, make sure that the groove on its outer periphery is positioned on the spring end.
2. Push the brush into the brush holder and secure with the brush pull-up pin. After reassembly, be sure to remove the pin.

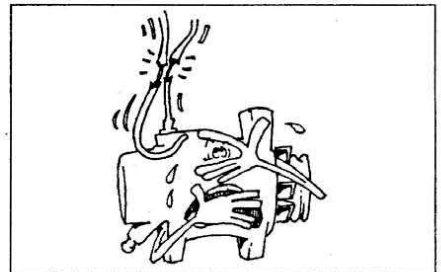
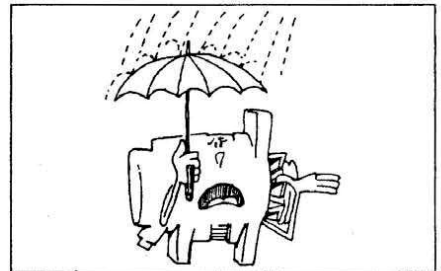
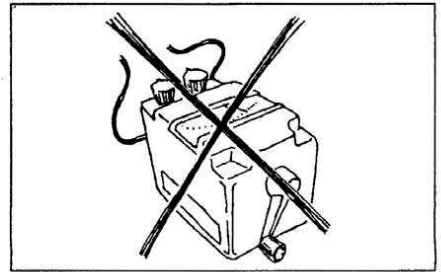
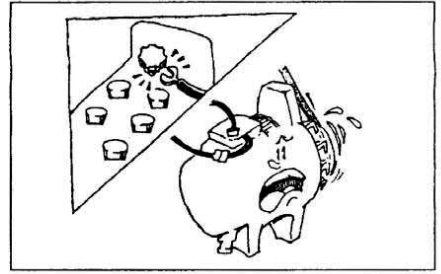
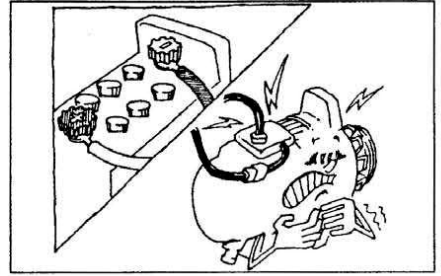


5.2.5 Tests

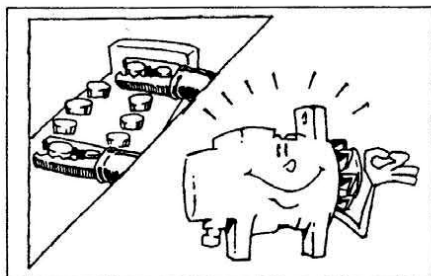
Handling Precautions

When servicing the alternator, observe the following precautions.

- (1) If the polarity of the battery is reversed when connections are made, a large current flows from the battery to alternator, damaging the diode and IC regulator.
- (2) Do not disconnect the battery terminal connections while the engine is running, or a surge voltage develops deteriorating the diode and regulator.
- (3) Do not use a megger or other high-voltage multimeter, or damaged diode and regulator will result.
- (4) When a steam cleaner is used, take adequate measures to prevent direct exposure of the alternator to the steam.
- (5) operating the alternator with its B and L terminals shorted results in the damaged diode trio.



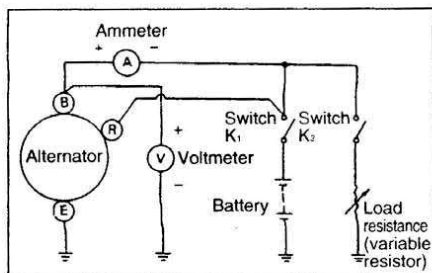
- (6) When quick-charging the battery with a quick charger, be sure to disconnect terminal connections in advance. otherwise, a damaged diode and regulator will result.



Performance Test (on test bench)

With the load resistance set at maximum (meaning that there is almost no load current flowing), close switches K_1 and K_2 .

While gradually increasing the alternator speed to reduce the load resistance, measure the current value with the specified terminal voltage and speed. If the measurement is below the specification, check alternator parts.



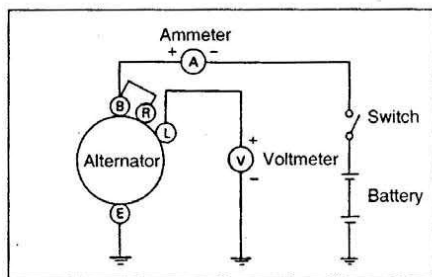
<Load characteristics>

Alternator	25 A type unit	
Terminal voltage	27V	27V
Current	14 A or more	22 A or more
Rotating speed	1,500 rpm	2,500 rpm

IC Regulator Regulated Voltage Test (On test bench)

Use a fully-charged battery.

Turn on the switch and gradually increase the alternator speed up to 5000 rpm. Check that the current value at this speed is 5 A or less. The regulator is in good condition if the regulated voltage under this condition is within specification. If not, replace the regulator assembly as the regulated voltage is not readjustable.



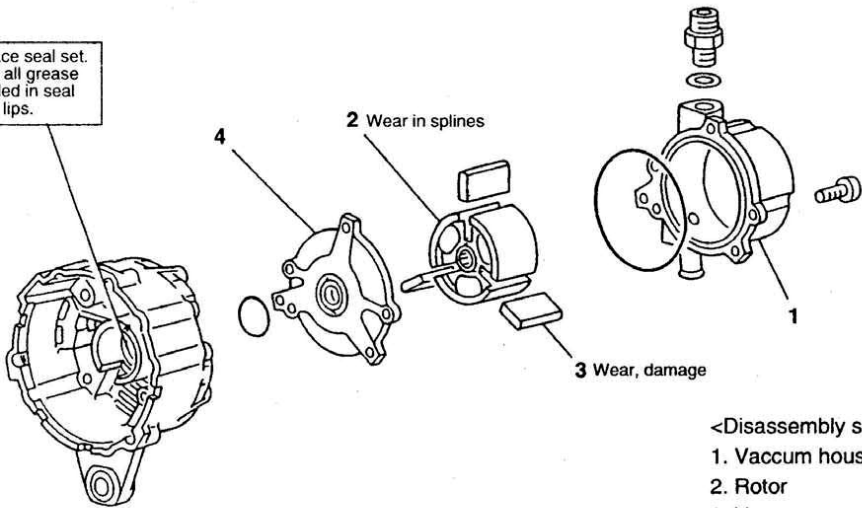
IC regulator regulated voltage

28 to 29 V (24 V type: 25 A alternator) 13.9 to 14.7 V (12 V type: 50 A alternator)	Measured across terminals L and E at 5,000 rpm, load 5 A or less
--	--

5.3 VACUUM PUMP

5.3.1 disassembly, Inspection and Reassembly

Replace seal set.
Apply all grease
included in seal
set to lips.



<Disassembly sequence>

1. Vacuum housing
2. Rotor
3. Vane
4. Plate

For reassembly, reverse the order of disassembly.

NOTE:

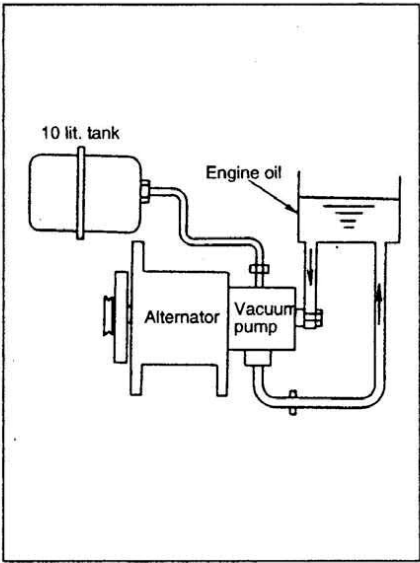
When reassembling the vacuum pump, make sure that the housing and rotor are free from metal particles and other contaminants.

5.3.2 Test

If the performance is below standards, check hose joints for tightness and the amount of oil supplied.

Then, recheck. If poor performance is still persistent, check vanes for chips; housing, rotor, and rear bracket mating surfaces for scratches; and, oil seals and check valves. Replace parts if defective.

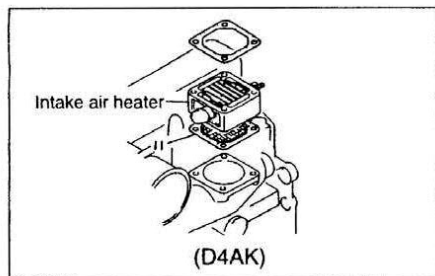
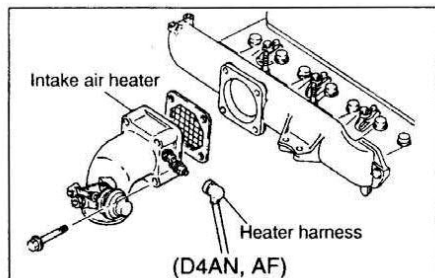
Maximum attainable vacuum		Vacuum	91 kPa(680 mmHg) or more
		Rotating speed	3,000 rpm
Deliver characteristics after 20 sec.(with 10 lit. tank)	At low speed	Vacuum	67 kPa(500 mmHg) or more
		Rotating speed	1,500 rpm
	At high speed	Vacuum	77 kPa(680 mmHg) or more
		Rotating speed	3,000 rpm



5.4 PREHEATING UNIT

5.4.1 Quick-heating Air Heater System

(1) Removal and Installation

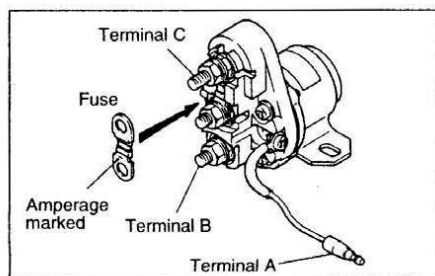


(2) Inspection of heater relay

Check to see if there is continuity between terminals B and C when an excitation current 2.3 A (24V) is applied across terminal A and body ground.

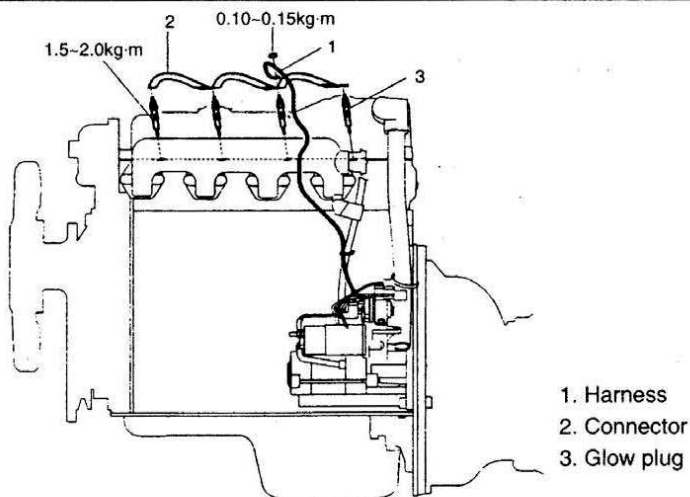
Check heater relay fuse and, if the fuse is blown, isolate the cause of trouble and replace the fuse.

Note the ampere stamped on the fuse at replacement.



5.4.2 Glow Plug (D4DA, D4AF)

(1) Removal and Installation.



(2) Inspection of glow plug

- (a) With the starter switch in "G" position, measure time required for the indicator to become red hot.

Nominal value: 15 to 35 seconds

- (b) If the measurement is out specification, or if the indicator does not become red hot, make the following checks.

If the specified time is not obtained, measure the resistance of glow plug at normal temperature.

Normal value:

24 V type

3.08 to 3.75 Ω

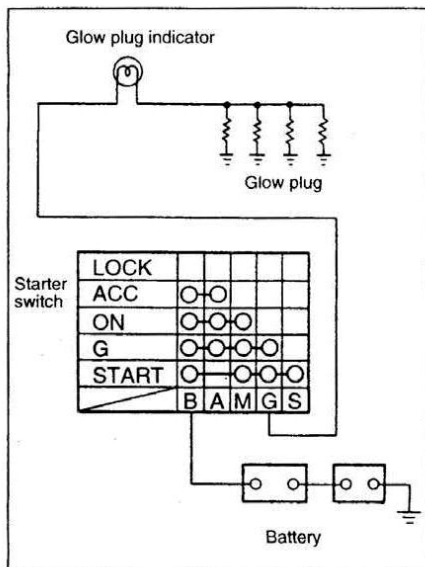
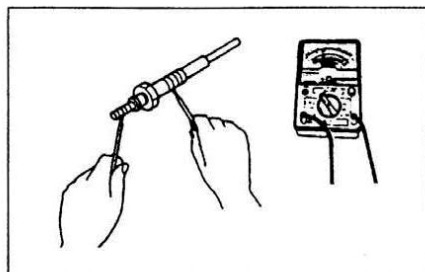
(20.5 V - 6 A $\pm 10\%$)

12 V type

1.14 to 1.39 Ω

(10.5 V - 8.3 A $\pm 10\%$)

If the indicator does not become red hot, check wirings and indicator for broken wires.

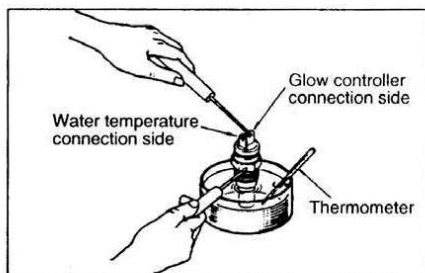


(3) Inspection of water temperature gauge unit.

Place the water temperature gauge unit in a container which contains water in it and measure the resistance when the specified water temperature is reached.

If the measurement is out of specifications, replace the water temperature gauge unit.

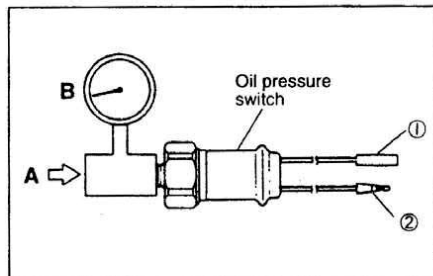
Water temperature	Nominal value
50℃	230 Ω
70℃	104 $\pm$ 13.5 Ω
90℃	52 Ω



(4) Inspection of engine oil pressure switch
perform the following checks. If defective, replace engine oil pressure switch.

- Under the condition where no air pressure A is applied to engine oil pressure switch, check to ensure that there is continuity between terminals ① and ②.
- Slowly apply air pressure A to engine oil pressure switch, beginning at 0 kpa(0 kgf/cm²).
When there is no more continuity between terminals ① and ②, measure the air pressure and check to ensure that the air pressure has the standard value.

B : Air pressure gauge

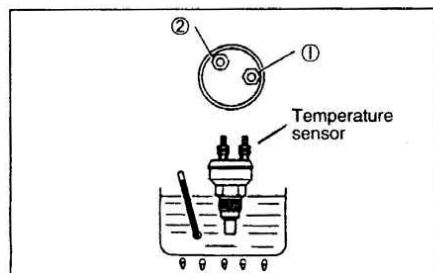


(5) Inspection of coolant temperature Sensor

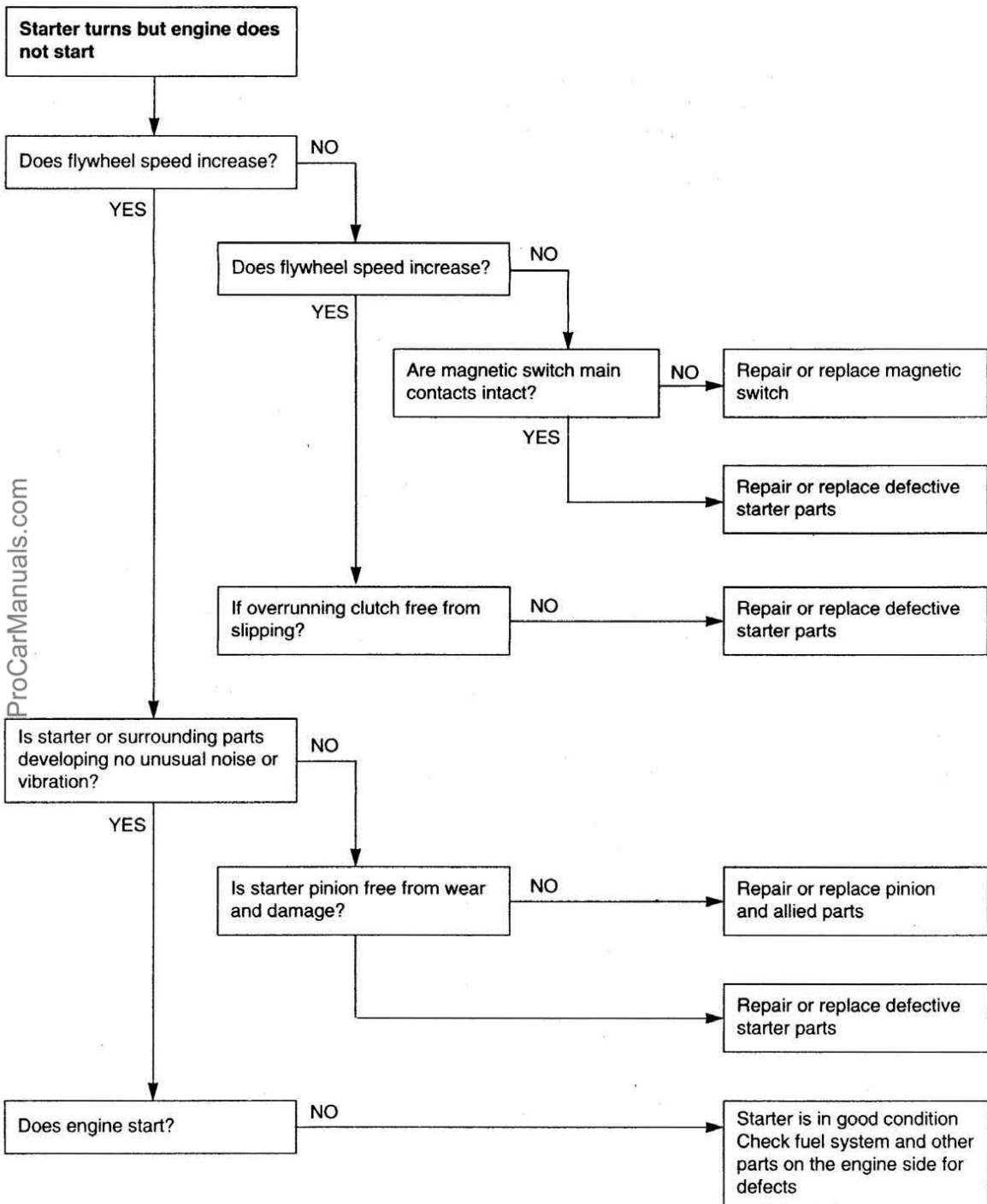
- Put coolant temperature sensor in a container filled with engine oil.
- Before raising the oil temperature, check to ensure that there is no continuity between terminals ① and ②.
- Slowly raise the oil temperature and stir the engine oil well.
- Measure the temperature at the time when there is continuity between terminals ① and ②.
- If the reading is out of the standard value, replace defective parts.

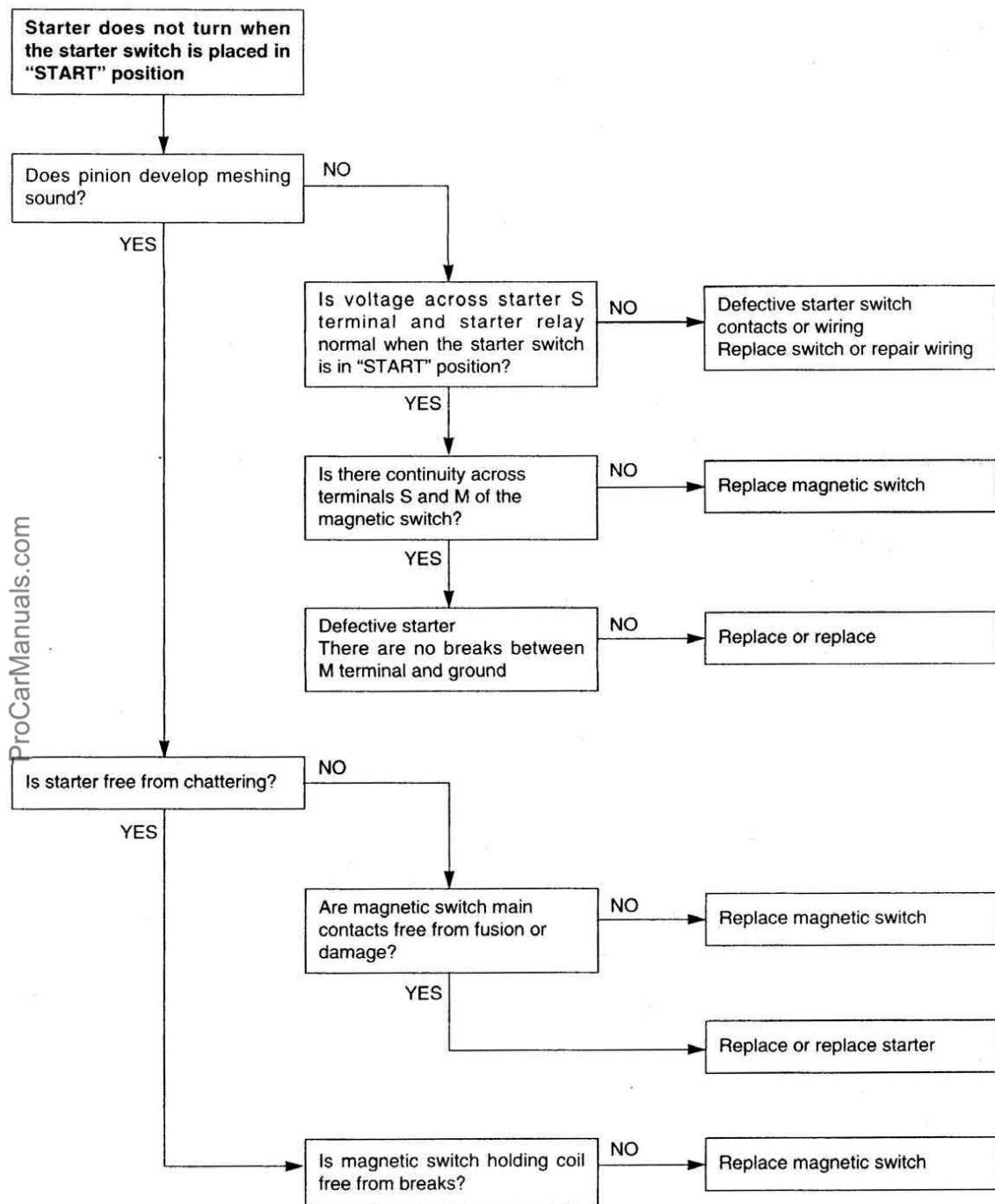
NOTE:

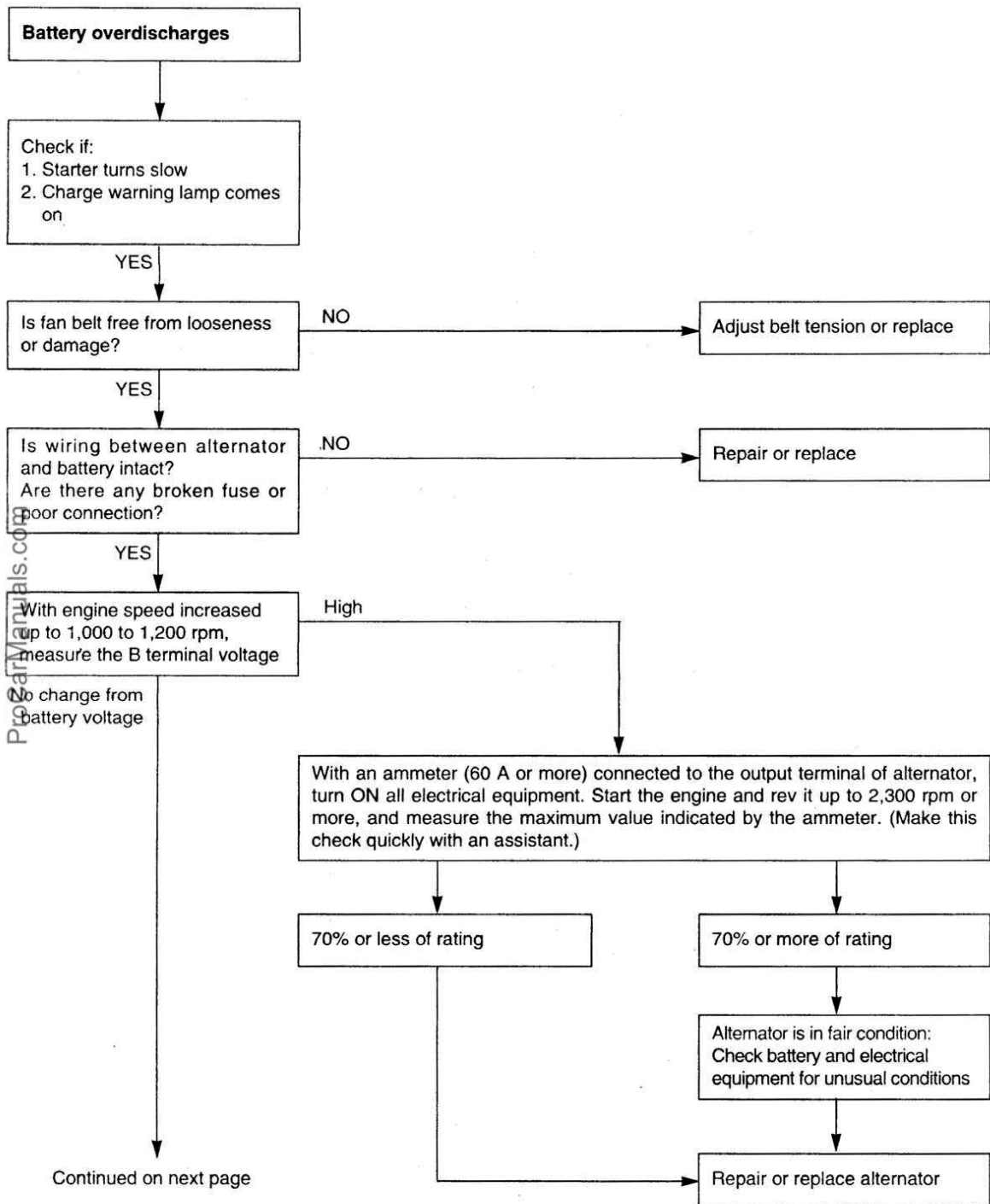
When the oil temperature is near the operating temperature, slowly heat the oil. (When the operating temperature -5℃ is reached, leave it alone for five minutes, and then raise the oil temperature at a rate of 1℃ in two or three minutes.)



6. TROUBLESHOOTING







Continued from previous page

