Alternators and Starter Motors

TECHNICAL MANUAL
Alternators and Starter Motors

CTM77 18JUL05 (ENGLISH)

John Deere Power Systems
LITHO IN U.S.A.

TP-6371 7/05

Introduction

Foreword

This manual is written for an experienced technician. Essential tools required in performing certain service work are identified in this manual and are recommended for use.

Live with safety: Read the safety messages in the introduction of this manual and the cautions presented throughout the text of the manual.

CAUTION: This is the safety-alert symbol. When you see this symbol on the machine or in this manual, be alert to the potential for personal injury.

This Component Technical Manual (CTM) contains the latest available instructions necessary to repair engine alternators and starter motors. It includes theory of operation, and diagnostic and testing procedures to help troubleshoot and understand potential failure modes.

The information is organized in sections and groups by various suppliers. At the beginning of each repair group are summary listings of all applicable essential tools, service equipment and tools, other materials needed to do the job, service parts kits, specifications, wear tolerances, and torque values.

Component Technical Manuals are concise service guides for specific components. They are written as stand-alone manuals covering multiple machine applications.

Fundamental service information is available from other sources covering basic theory of operation, fundamentals of troubleshooting, general maintenance, and basic types of failures and their causes.

This manual covers alternator and starter motor applications for all John Deere diesel engines—both older 300/400/500-Series and newer *POWERTECH*® and PowerTech Plus™ **2.4 L—13.5 L engines. This manual covers components for both Deere OEM engines and Deere machine engine applications.**

NOTE: Remanufactured alternators and starter motors are available for replacement on most applications listed in this manual. Refer to John Deere's "Remanufactured Components" catalogs PC2344 (Ag), PC2345 (CE) and PC2346 (C&CE) to cross-reference your original equipment part number and obtain a suitable remanufactured replacement starter or alternator.

IFC,CTM77 –19–15JUL05–1/1

John Deere Dealers

IMPORTANT: Please copy this page listing changes and route it through your service department.

This CTM is a complete revision of CTM77, Alternators and Starter Motors, dated 25 Sep 02. **Discard CTM77 dated 25 Sep 02 and replace it with this new manual.**

This manual covers alternators and starter motors on all John Deere and OEM applications manufactured since 1972, except 40, 50 and 55 Series Utility Tractors.

Revised information includes:

1. Updated test specifications for all current alternators and starter motors, including those adopted since the 25 Sep 02 edition.
2. Added new applications for all current alternators and starter motors.
3. Added new Bosch alternator pulley removal procedure to Section 30, Group 10.
4. Updated torque charts in Section 05, Group 10.

OURGP11,0000053 –19–15JUL05–1/1

Contents

Continued on next page

All information, illustrations and specifications in this manual are based on the latest information available at the time of publication. The right is reserved to make changes at any time without notice.

Section 05
Introduction and Safety Information

Contents

Handle Fluids Safely—Avoid Fires

When you work around fuel, do not smoke or work near heaters or other fire hazards.

Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.

Make sure machine is clean of trash, grease, and debris.

Do not store oily rags; they can ignite and burn spontaneously.

TS227 –UN–23AUG88

DX,FLAME –19–29SEP98–1/1

Prevent Battery Explosions

Keep sparks, lighted matches, and open flame away from the top of battery. Battery gas can explode.

Never check battery charge by placing a metal object across the posts. Use a volt-meter or hydrometer.

Do not charge a frozen battery; it may explode. Warm battery to 16°C (60°F).

TS204 –UN–23AUG88

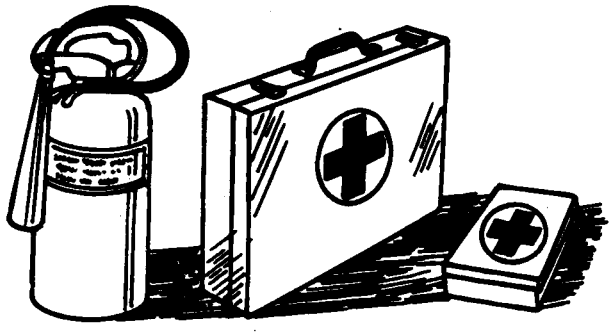
DX,SPARKS –19–03MAR93–1/1

Prepare for Emergencies

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



TS291 –UN–23AUG88

DX,FIRE2 –19–03MAR93–1/1

05
05
2

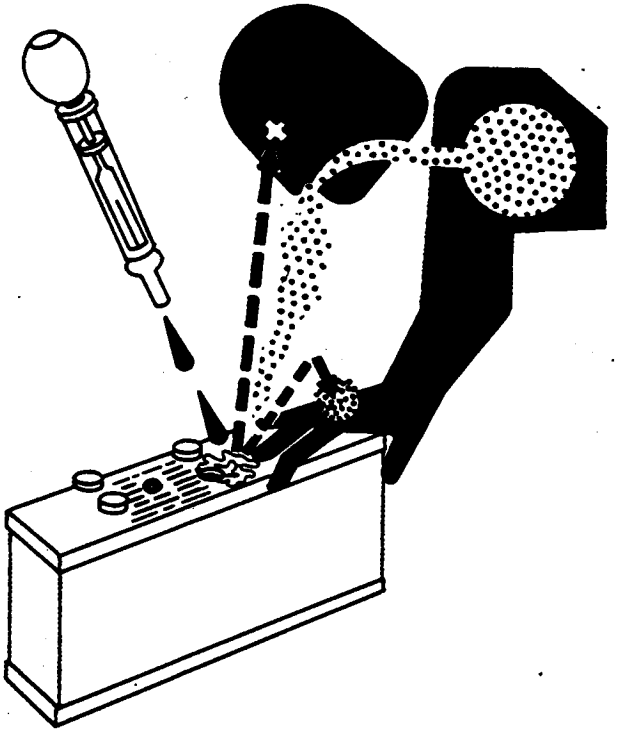
Handling Batteries Safely

TS204 –UN–23AUG88

CAUTION: Battery gas can explode. Keep sparks and flames away from batteries. Use a flashlight to check battery electrolyte level.

Never check battery charge by placing a metal object across the posts. Use a voltmeter or hydrometer.

Always remove grounded (—) battery clamp first and replace it last.



TS203 –UN–23AUG88

CAUTION: Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid the hazard by:

1. **Filling batteries in a well-ventilated area.**
2. **Wearing eye protection and rubber gloves.**
3. **Avoiding breathing fumes when electrolyte is added.**
4. **Avoiding spilling or dripping electrolyte.**
5. **Using proper jump start procedure.**

If you spill acid on yourself:

1. **Flush your skin with water.**
2. **Apply baking soda or lime to help neutralize the acid.**
3. **Flush your eyes with water for 15—30 minutes. Get medical attention immediately.**

If acid is swallowed:

1. **Do not induce vomiting.**
2. **Drink large amounts of water or milk, but do not exceed 2 L (2 quarts).**
3. **Get medical attention immediately.**

WARNING: Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. **Wash hands after handling.**

DPSG,OUO1004,2758 –19–11MAY00–1/1

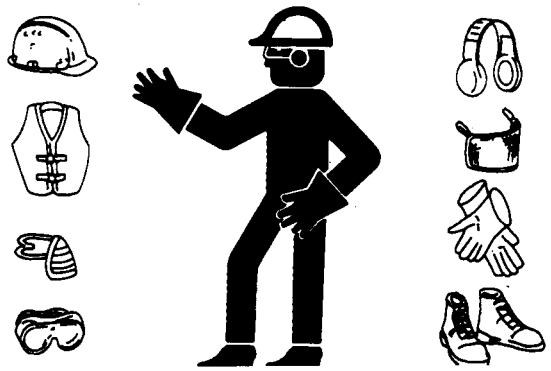
Wear Protective Clothing

Wear close fitting clothing and safety equipment appropriate to the job.

Prolonged exposure to loud noise can cause impairment or loss of hearing.

Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

Operating equipment safely requires the full attention of the operator. Do not wear radio or music headphones while operating machine.



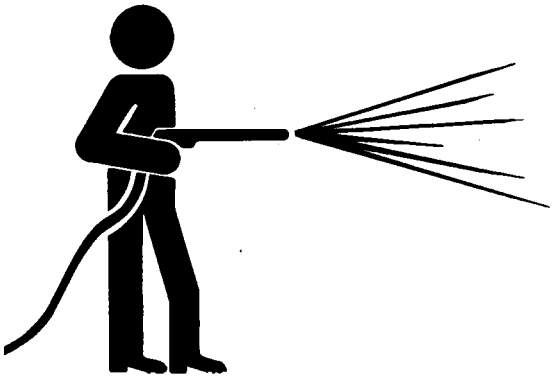
TS206 –UN–23AUG88

DX,WEAR –19–10SEP90–1/1

Work in Clean Area

Before starting a job:

- Clean work area and machine.
- Make sure you have all necessary tools to do your job.
- Have the right parts on hand.
- Read all instructions thoroughly; do not attempt shortcuts.



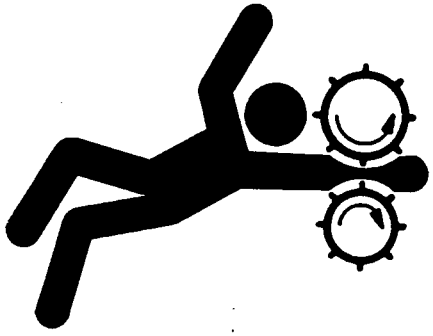
T6642EJ –UN–18OCT88

DX,CLEAN –19–04JUN90–1/1

Service Machines Safely

Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing, or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



TS228 –UN–23AUG88

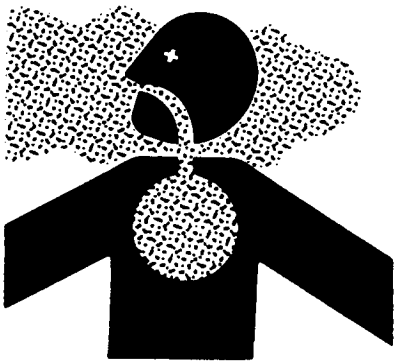
DX,LOOSE –19–04JUN90–1/1

05
05
4

Work In Ventilated Area

Engine exhaust fumes can cause sickness or death. If it is necessary to run an engine in an enclosed area, remove the exhaust fumes from the area with an exhaust pipe extension.

If you do not have an exhaust pipe extension, open the doors and get outside air into the area

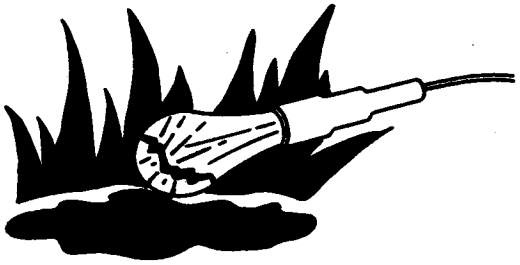


TS220 –UN–23AUG88

DX,AIR –19–17FEB99–1/1

Illuminate Work Area Safely

Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.



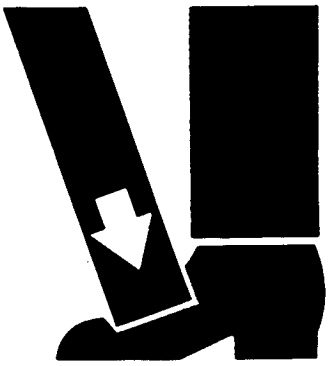
TS223 –UN–23AUG88

DX,LIGHT –19–04JUN90–1/1

Use Proper Lifting Equipment

Lifting heavy components incorrectly can cause severe injury or machine damage.

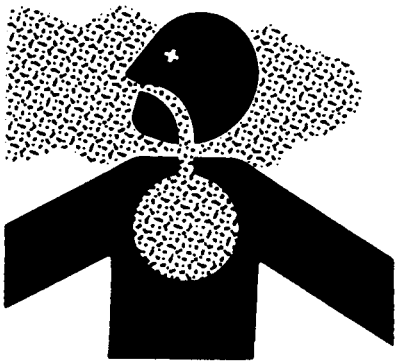
Follow recommended procedure for removal and installation of components in the manual.



TS226 –UN–23AUG88

DX,LIFT –19–04JUN90–1/1

Remove Paint Before Welding or Heating



TS220 –UN–23AUG88

Avoid potentially toxic fumes and dust.

Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch.

Remove paint before heating:

- Remove paint a minimum of 76 mm (3 in.) from area to be affected by heating.
- If you sand or grind paint, avoid breathing the dust. Wear an approved respirator.
- If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.

Do not use a chlorinated solvent in areas where welding will take place.

Do all work in an area that is well ventilated to carry toxic fumes and dust away.

Dispose of paint and solvent properly.

DX,PAINT –19–19JUL01–1/1

05
05
6

Practice Safe Maintenance

Understand service procedure before doing work. Keep area clean and dry.

Never lubricate, service, or adjust machine while it is moving. Keep hands, feet , and clothing from power-driven parts. Disengage all power and operate controls to relieve pressure. Lower equipment to the ground. Stop the engine. Remove the key. Allow machine to cool.

Securely support any machine elements that must be raised for service work.

Keep all parts in good condition and properly installed. Fix damage immediately. Replace worn or broken parts. Remove any buildup of grease, oil, or debris.

On self-propelled equipment, disconnect battery ground cable (-) before making adjustments on electrical systems or welding on machine.

On towed implements, disconnect wiring harnesses from tractor before servicing electrical system components or welding on machine.

TS218 –UN–23AUG88

DX,SERV –19–17FEB99–1/1

Use Proper Tools

Use tools appropriate to the work. Makeshift tools and procedures can create safety hazards.

Use power tools only to loosen threaded parts and fasteners.

For loosening and tightening hardware, use the correct size tools. DO NOT use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches.

Use only service parts meeting John Deere specifications.

TS779 –UN–08NOV89

DX,REPAIR –19–17FEB99–1/1

Dispose of Waste Properly

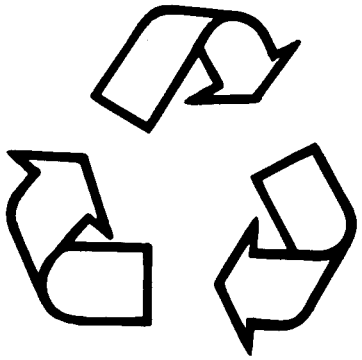
Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with John Deere equipment include such items as oil, fuel, coolant, brake fluid, filters, and batteries.

Use leakproof containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

Do not pour waste onto the ground, down a drain, or into any water source.

Air conditioning refrigerants escaping into the air can damage the Earth's atmosphere. Government regulations may require a certified air conditioning service center to recover and recycle used air conditioning refrigerants.

Inquire on the proper way to recycle or dispose of waste from your local environmental or recycling center, or from your John Deere dealer.



TS1133 –UN–26NOV90

DX,DRAIN –19–03MAR93–1/1

Prevent Machine Runaway

Avoid possible injury or death from machinery runaway.

Do not start engine by shorting across starter terminals. Machine will start in gear if normal circuitry is bypassed.

NEVER start engine while standing on ground. Start engine only from operator's seat, with transmission in neutral or park.

TS177 –UN–11JAN89

DX,BYPAS1 –19–29SEP98–1/1

Live With Safety

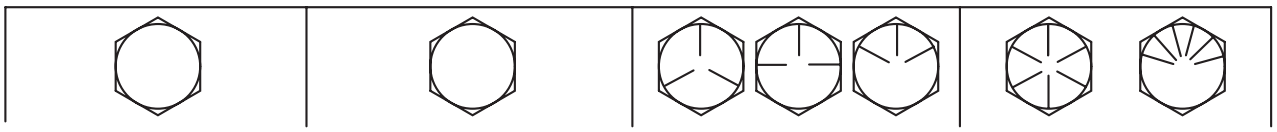
Before returning machine to customer, make sure machine is functioning properly, especially the safety systems. Install all guards and shields.

TS231 –19–07OCT88

DX,LIVE –19–25SEP92–1/1

Unified Inch Bolt and Screw Torque Values

TS1671 –UN–01MAY03



Bolt or	SAE Grade 1				SAE Grade 2[a]				SAE Grade 5, 5.1 or 5.2				SAE Grade 8 or 8.2			
Screw	Lubricated[b]		Dry[c]		Lubricated[b]		Dry[c]		Lubricated[b]		Dry[c]		Lubricated[b]		Dry[c]	
Size	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in
1/4	3.7	33	4.7	42	6	53	7.5	66	9.5	84	12	106	13.5	120	17	150
													N•m	lb-ft	N•m	lb-ft
5/16	7.7	68	9.8	86	12	106	15.5	137	19.5	172	25	221	28	20.5	35	26
									N•m	lb-ft	N•m	lb-ft				
3/8	13.5	120	17.5	155	22	194	27	240	35	26	44	32.5	49	36	63	46
			N•m	lb-ft	N•m	lb-ft	N•m	lb-ft								
7/16	22	194	28	20.5	35	26	44	32.5	56	41	70	52	80	59	100	74
	N•m	lb-ft														
1/2	34	25	42	31	53	39	67	49	85	63	110	80	120	88	155	115
9/16	48	35.5	60	45	76	56	95	70	125	92	155	115	175	130	220	165
5/8	67	49	85	63	105	77	135	100	170	125	215	160	240	175	305	225
3/4	120	88	150	110	190	140	240	175	300	220	380	280	425	315	540	400
7/8	190	140	240	175	190	140	240	175	490	360	615	455	690	510	870	640
1	285	210	360	265	285	210	360	265	730	540	920	680	1030	760	1300	960
1-1/8	400	300	510	375	400	300	510	375	910	670	1150	850	1450	1075	1850	1350
1-1/4	570	420	725	535	570	420	725	535	1280	945	1630	1200	2050	1500	2600	1920
1-3/8	750	550	950	700	750	550	950	700	1700	1250	2140	1580	2700	2000	3400	2500
1-1/2	990	730	1250	930	990	730	1250	930	2250	1650	2850	2100	3600	2650	4550	3350

Torque values listed are for general use only, based on the strength of the bolt or screw. DO NOT use these values if a different torque value or tightening procedure is given for a specific application. For plastic insert or crimped steel type lock nuts, for stainless steel fasteners, or for nuts on U-bolts, see the tightening instructions for the specific application. Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.

Replace fasteners with the same or higher grade. If higher grade fasteners are used, tighten these to the strength of the original. Make sure fastener threads are clean and that you properly start thread engagement. When possible, lubricate plain or zinc plated fasteners other than lock nuts, wheel bolts or wheel nuts, unless different instructions are given for the specific application.

[a]Grade 2 applies for hex cap screws (not hex bolts) up to 6. in (152 mm) long. Grade 1 applies for hex cap screws over 6 in. (152 mm) long, and for all other types of bolts and screws of any length.

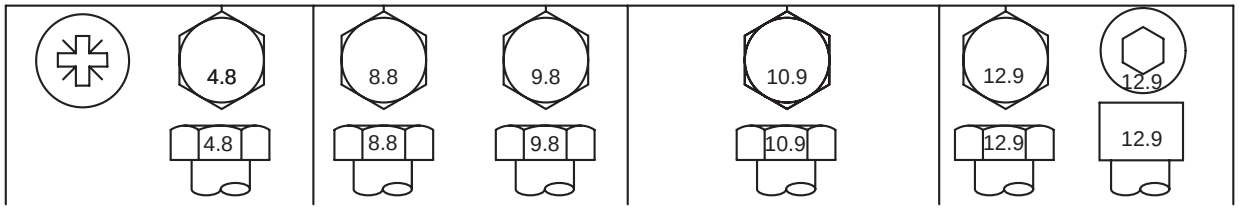
[b]"Lubricated" means coated with a lubricant such as engine oil, fasteners with phosphate and oil coatings, or 7/8 in. and larger fasteners with JDM F13C zinc flake coating.

[c]"Dry" means plain or zinc plated without any lubrication, or 1/4 to 3/4 in. fasteners with JDM F13B zinc flake coating.

TORQ1 –19–24APR03–1/1

05
10
2

Metric Bolt and Screw Torque Values



TS1670 –UN–01MAY03

Bolt or	Class 4.8				Class 8.8 or 9.8				Class 10.9				Class 12.9			
Screw	Lubricated[a]		Dry[b]		Lubricated[a]		Dry[b]		Lubricated[a]		Dry[b]		Lubricated[a]		Dry[b]	
Size	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in
M6	4.7	42	6	53	8.9	79	11.3	100	13	115	16.5	146	15.5	137	19.5	172
									N•m	lb-ft	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft
M8	11.5	102	14.5	128	22	194	27.5	243	32	23.5	40	29.5	37	27.5	47	35
			N•m	lb-ft	N•m	lb-ft	N•m	lb-ft								
M10	23	204	29	21	43	32	55	40	63	46	80	59	75	55	95	70
	N•m	lb-ft														
M12	40	29.5	50	37	75	55	95	70	110	80	140	105	130	95	165	120
M14	63	46	80	59	120	88	150	110	175	130	220	165	205	150	260	190
M16	100	74	125	92	190	140	240	175	275	200	350	255	320	235	400	300
M18	135	100	170	125	265	195	330	245	375	275	475	350	440	325	560	410
M20	190	140	245	180	375	275	475	350	530	390	675	500	625	460	790	580
M22	265	195	330	245	510	375	650	480	725	535	920	680	850	625	1080	800
M24	330	245	425	315	650	480	820	600	920	680	1150	850	1080	800	1350	1000
M27	490	360	625	460	950	700	1200	885	1350	1000	1700	1250	1580	1160	2000	1475
M30	660	490	850	625	1290	950	1630	1200	1850	1350	2300	1700	2140	1580	2700	2000
M33	900	665	1150	850	1750	1300	2200	1625	2500	1850	3150	2325	2900	2150	3700	2730
M36	1150	850	1450	1075	2250	1650	2850	2100	3200	2350	4050	3000	3750	2770	4750	3500

Torque values listed are for general use only, based on the strength of the bolt or screw. DO NOT use these values if a different torque value or tightening procedure is given for a specific application. For stainless steel fasteners or for nuts on U-bolts, see the tightening instructions for the specific application. Tighten plastic insert or crimped steel type lock nuts by turning the nut to the dry torque shown in the chart, unless different instructions are given for the specific application.

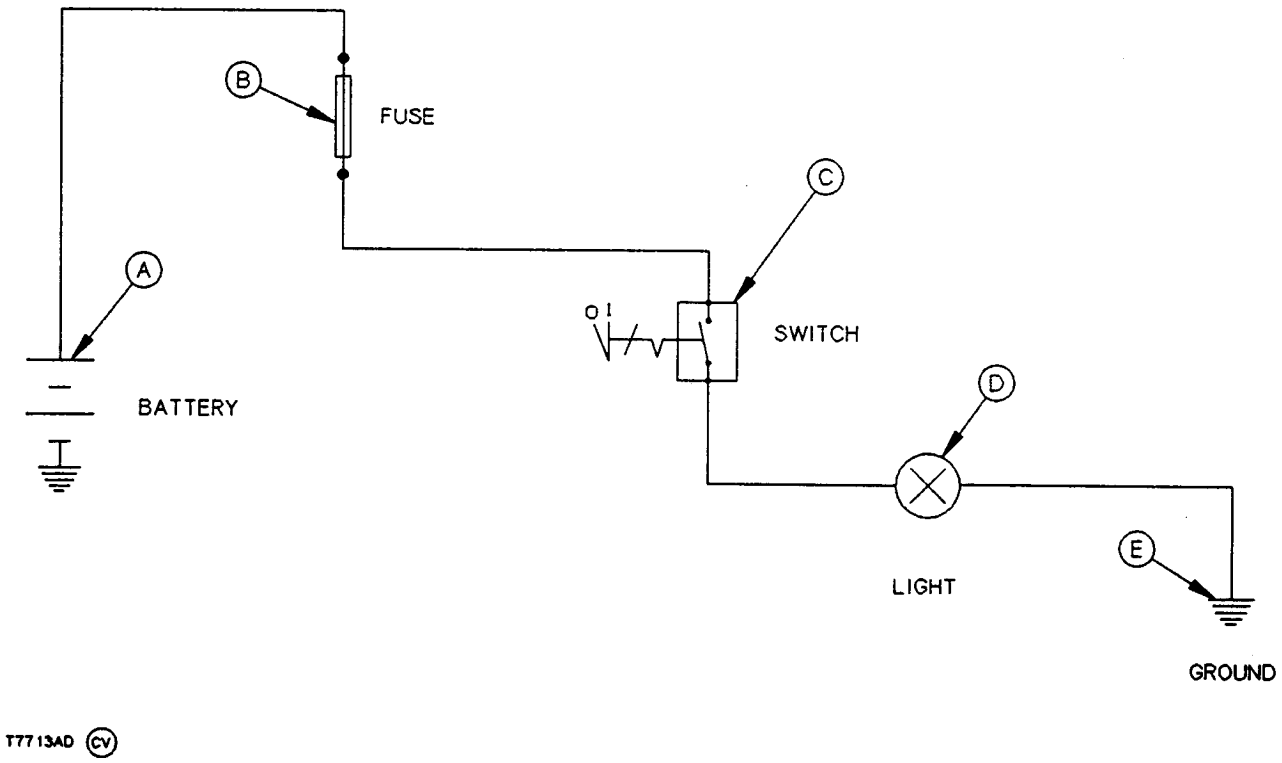
Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical property class. Replace fasteners with the same or higher property class. If higher property class fasteners are used, tighten these to the strength of the original. Make sure fastener threads are clean and that you properly start thread engagement. When possible, lubricate plain or zinc plated fasteners other than lock nuts, wheel bolts or wheel nuts, unless different instructions are given for the specific application.

[a]"Lubricated" means coated with a lubricant such as engine oil, fasteners with phosphate and oil coatings, or M20 and larger fasteners with JDM F13C zinc flake coating.

[b]"Dry" means plain or zinc plated without any lubrication, or M6 to M18 fasteners with JDM F13B zinc flake coating.

DX,TORQ2 –19–24APR03–1/1

Electrical Circuit Malfunctions



T7713AD –19–27FEB92

A—Battery **C—Switch** **D—Light** **E—Ground**
B—Fuse

1. There are four common circuit malfunctions.

   - High-Resistance Circuit
   - Open Circuit
   - Grounded Circuit
   - Shorted Circuit

2. Three sections in a simple circuit where these malfunctions can occur:

   - Before the controlling switch (C).
   - Between the controlling switch and before the component, light (D).
   - After the component.

Component malfunctions can easily be confused with circuit malfunctions. Therefore, care must be exercised when isolating the cause of a problem.

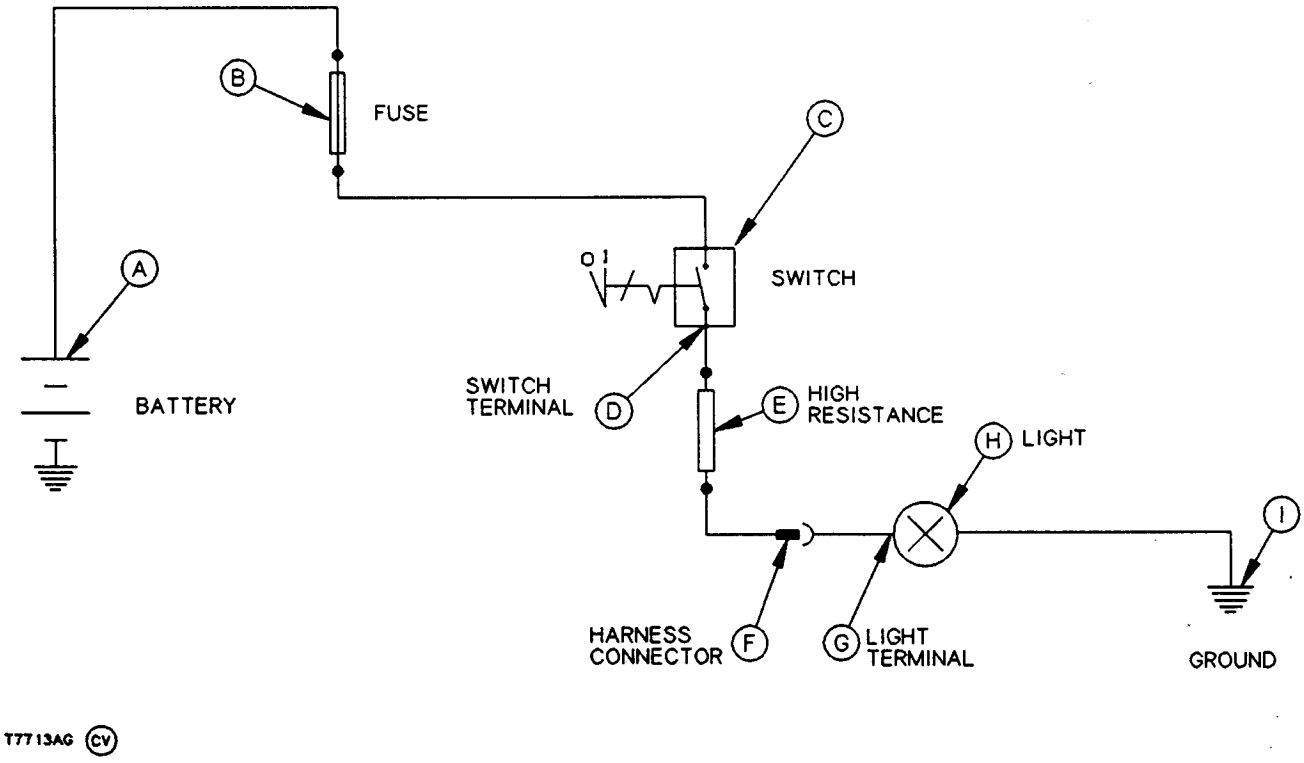
Example: Light does not operate or is dim when switch is turned ON, until switch connector is disconnected and reconnected.

Reason: High resistance caused by a dirty switch connector, caused a voltage drop which prevented the proper amount of current from flowing to the light.

DPSG,OUO1004,785 –19–19APR99–1/1

05
15
2

High Resistance Circuit



T7713AG –19–26FEB92

A—Battery
B—Fuse
C—Switch
D—Switch Terminal
E—High Resistance
F—Harness Connector
G—Light Terminal
H—Light
I—Ground

A high resistance circuit can result in slow, dim or no component operation.

Examples: Loose, corroded, dirty or oily terminals. Wire size too small. Strands broken inside the wire. Poor ground connection to frame.

To locate the cause of high resistance:

With switch (C) ON, check for battery voltage between switch and ground (I) at an easily accessible location, like harness connector (F).

If less than battery voltage is indicated, check again closer to switch.

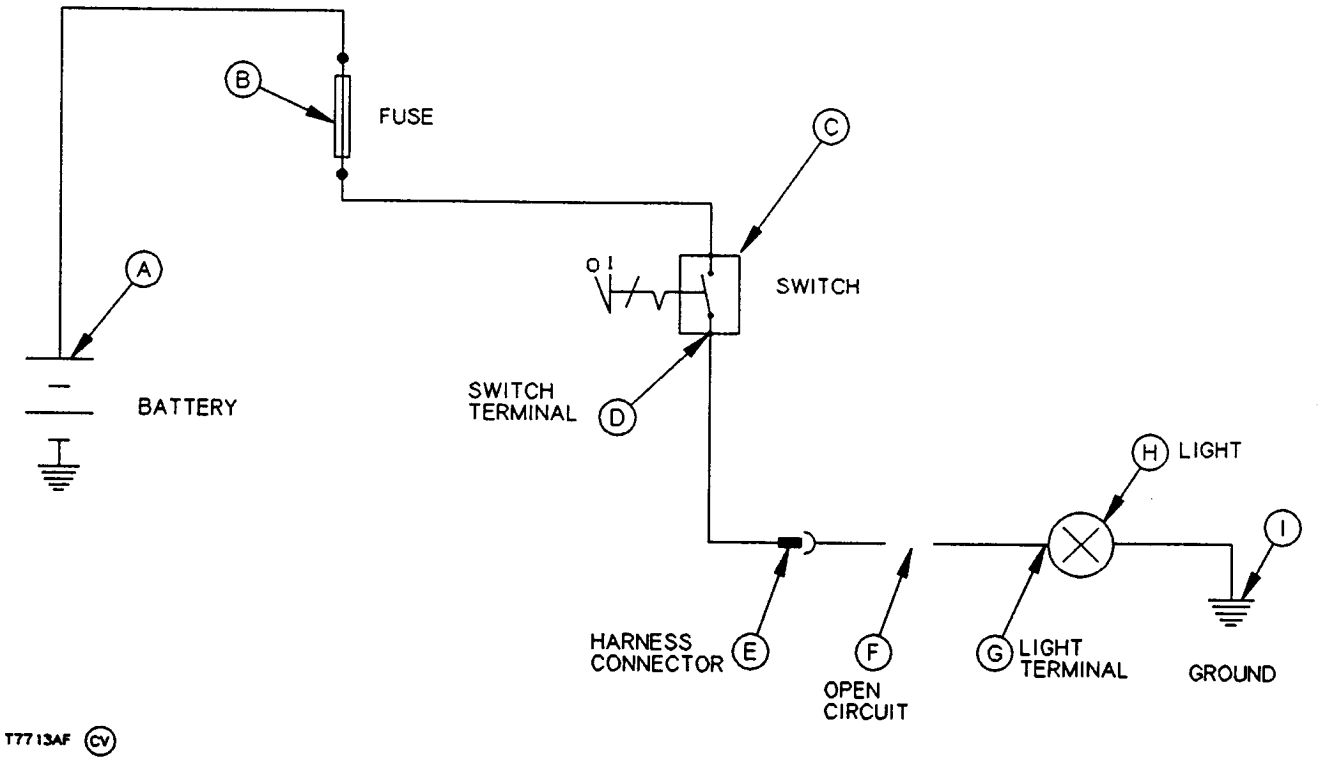
If battery voltage is indicated, check closer to ground to locate point of voltage drop. The example shows high resistance (E) between switch and harness connector.

Repair circuit as required. In the example, strands were broken inside the wire. Replace that section of wire.

Repeat check-out procedure after repair.

DPSG,OUO1004,660 –19–15MAR99–1/1

Open Circuit



A—Battery
B—Fuse
C—Switch
D—Switch Terminal
E—Harness Connector
F—Open Circuit
G—Light Terminal
H—Light
I—Ground

An open circuit will result in no components operating. Fuse may or may not be blown.

Example: Broken wire, disconnected component terminal, pins inside a connector not making contact, blown fuse, open circuit breaker, failed switch or component, or a disconnected ground wire.

To locate an open circuit:

Check fuse. If blown, replace and operate circuit. If fuse blows a second time, continue check.

With switch (C) ON, check for battery voltage at switch terminal (D).

If no voltage is indicated, check switch, fuse and wiring to battery.

If battery voltage is indicated, check for voltage closer to ground at harness connector (E).

If no voltage is indicated, wire may be broken between switch and connector.

If battery voltage is indicated, inspect connector pins. If pins are OK, check for voltage at light terminal (G).

In the example, zero voltage will be indicated at light terminal, indicating a broken wire between harness connector and light terminal.

If battery voltage had been indicated, the next check for voltage would be at ground connection (I).

Normal indicated voltage at a ground connection should be 0.0 to 0.5 volts.

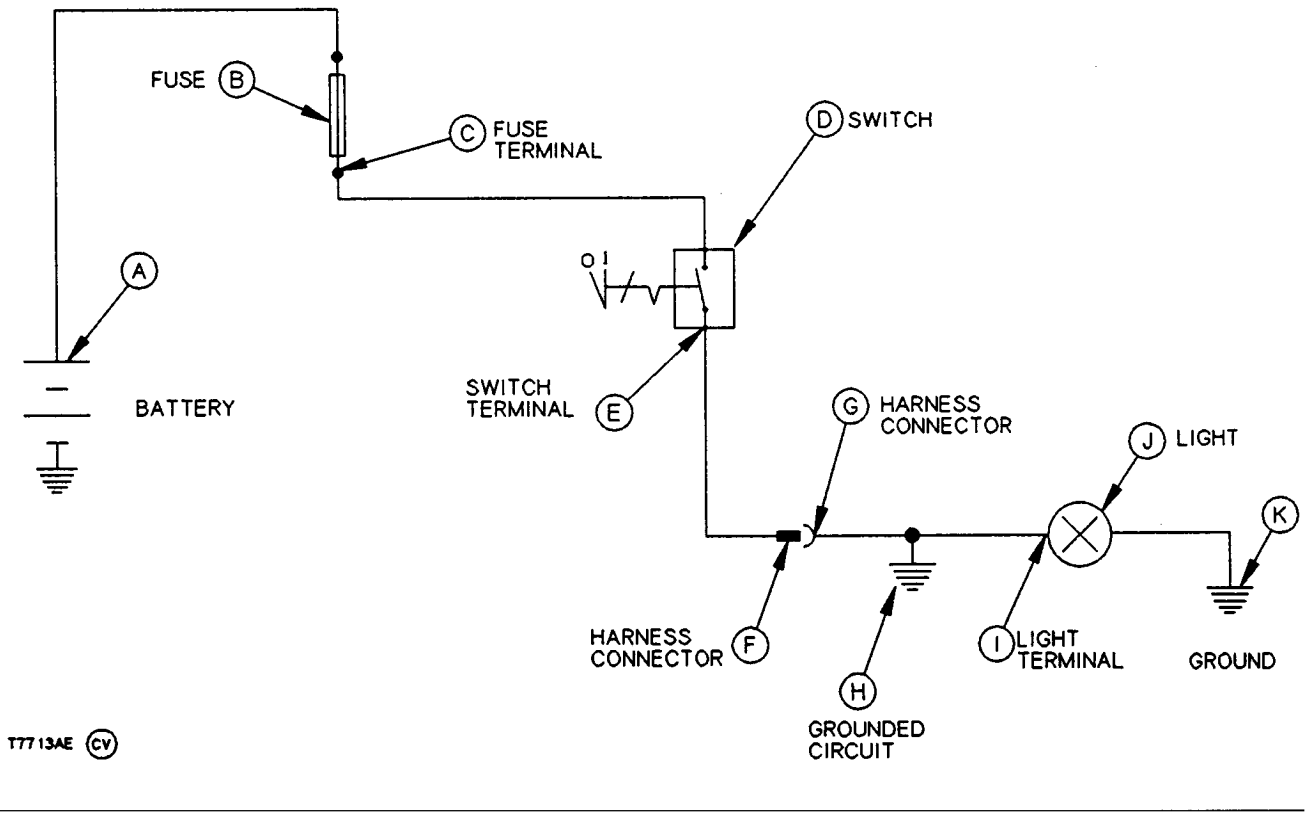
Continued on next page

05
15
4

If battery voltage is indicated, poor connection to frame or broken wire is indicated.	When problem is located, repair as needed, then repeat last check.

DPSG,OUO1004,661 –19–15MAR99–2/2

Grounded Circuit



A—Battery
B—Fuse
C—Fuse Terminal
D—Switch
E—Switch Terminal
F—Harness Connector
G—Harness Connector
H—Grounded Circuit
I—Light (Component) Terminal
J—Light
K—Ground

If no component operates, the fuse is blown and replacement fuses blow immediately or the circuit breaker is open and reopens when reset, a grounded circuit exists. (Example: power wire contacting frame or other metal component). A wire may be pinched or insulation may be worn from a wire. To isolate the location of a grounded circuit:

If circuit is grounded between battery and fuse, wire will be burned and circuit will be open. Fuse will not be blown.

If fuse is blown, remove fuse from circuit, disconnect circuit near its center, such as harness connector (F). Turn switch (D) ON and check for continuity to ground at harness connector (F). This will check harness from harness connector to fuse.

If continuity to ground is indicated, there is a pinched or bare wire between fuse terminal (C) and harness connector (F).

If continuity to ground does not exist, disconnect ground (K) from frame. Measure continuity to ground at harness connector (G). This checks harness from harness connector to ground terminal. In the example, continuity to ground will exist because circuit is grounded (wire is pinched) at (H).

If continuity exists, disconnect circuit at light terminal (I) and measure continuity to ground on light terminal. This checks harness from light to ground terminal. In the example, continuity will not exist, indicating a grounded circuit between the light and harness connector (G).

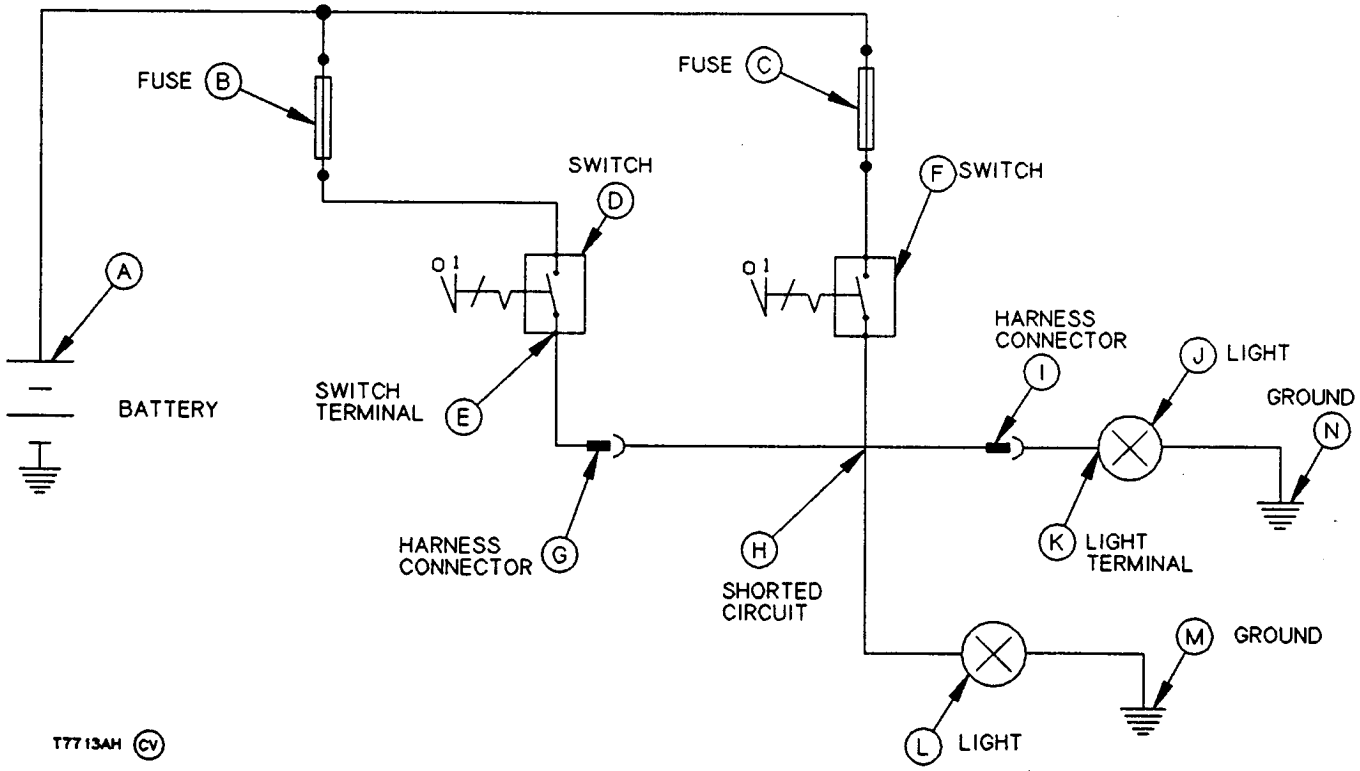
Continued on next page

05
15
6

Repeat check-out procedure after repair.

DPSG,OUO1004,662 –19–15MAR99–2/2

Shorted Circuit



T7713AH –19–27FEB92

A—Battery
B—Fuse
C—Fuse
D—Switch
E—Switch Terminal
F—Switch
G—Harness Connector
H—Shorted Circuit
I—Harness Connector
J—Light
K—Light Terminal
L—Light
M—Ground
N—Ground

A shorted circuit causes components in separate circuits to operate when a switch in either circuit is turned ON. (Example: two harnesses rubbing together until insulation is worn through, allowing bare wires to touch). Components can also become shorted. However, shorted components will usually blow the fuse.

To locate a shorted circuit:

Turn switch (F) ON then OFF. Turn switch (D) ON then OFF. Both lights (J and L) will be ON when either switch (D or F) is ON.

Turn switch (F) ON. Both lights (J and L) will be ON; only light (L) should be ON.

Disconnect wire from switch of component that should not be ON. In the example, disconnect wire from terminal (E) at switch (D). Light (J) remains ON.

Disconnect circuit at convenient places like harness connectors (G) and (I) and light terminal (K) until light (J) goes OFF.

The short circuit will be between the last two places the circuit was disconnected. In the example, it is between harness connectors (G and I). Light (J) will go OFF when harness connector (I) is disconnected. Inspect harness between connectors (G and I).

Continued on next page

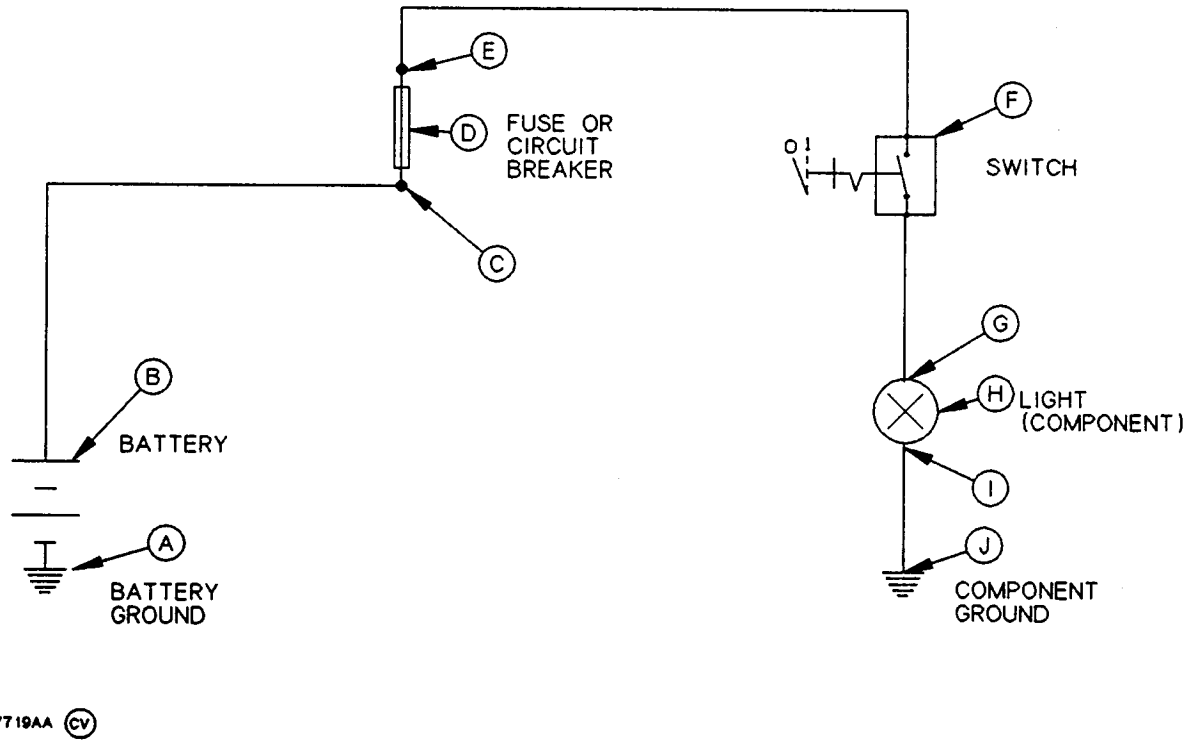
05
15
8

Repair or replace wires and harnesses as needed. Install tie bands and clamps on harnesses as required to prevent future problems.

Repeat check-out procedure after repair.

DPSG,OUO1004,664 –19–15MAR99–2/2

Seven Step Electrical Test Procedure



T7719AA –19–05MAR92

A—Battery Ground
B—Battery
C—Battery Side of Fuse or Circuit Breaker
D—Fuse or Circuit Breaker
E—Component Side of Fuse or Circuit Breaker
F—Switch
G—Battery Side of Component Terminal
H—Light (Component)
I—Ground Side of Component Terminal
J—Component Ground

Continued on next page

DPSG,OUO1004,666 –19–15MAR99–1/2

Step 1—Switch ON	
Check battery side of circuit breaker (C) for battery voltage.	Battery voltage normal, go to Step 2. Low voltage, repair high resistance. Open circuit from battery.
Step 2—Switch OFF	
Check component side of circuit breaker (E) for battery voltage.	Battery voltage normal, go to Step 4. Low voltage, repair high resistance. No voltage, go to Step 3.
Step 3—Switch OFF	
Check component side of circuit breaker (E) for continuity to ground.	Continuity to ground, repair grounded circuit at or before switch. No continuity to ground, replace circuit breaker.
Step 4—Switch ON	
Check component side of circuit breaker (E) for battery voltage.	Battery voltage normal, go to Step 6. Low voltage, repair high resistance. No voltage, go to Step 5.
Step 5 [a]	
Disconnect wire at battery side of component (G). Switch ON. Check wire at (G) for battery voltage.	Battery voltage, repair component. No voltage, repair grounded or open circuit at or after switch.
Step 6—Switch ON	
Check lead to component at (G) for battery voltage.	Battery voltage normal, go to Step 7. Low voltage, repair high resistance in circuit between fuse and component. No voltage, repair high resistance or open circuit between fuse and component.
Step 7—Switch ON	
Check ground wire of component at (I) for voltage.	No voltage, good continuity to ground, repair component. Voltage, poor continuity to ground, repair high resistance or open ground circuit.

[a]A multimeter will not apply a load to the circuit at Step 5. The multimeter result is tested as a voltage condition in the result column.

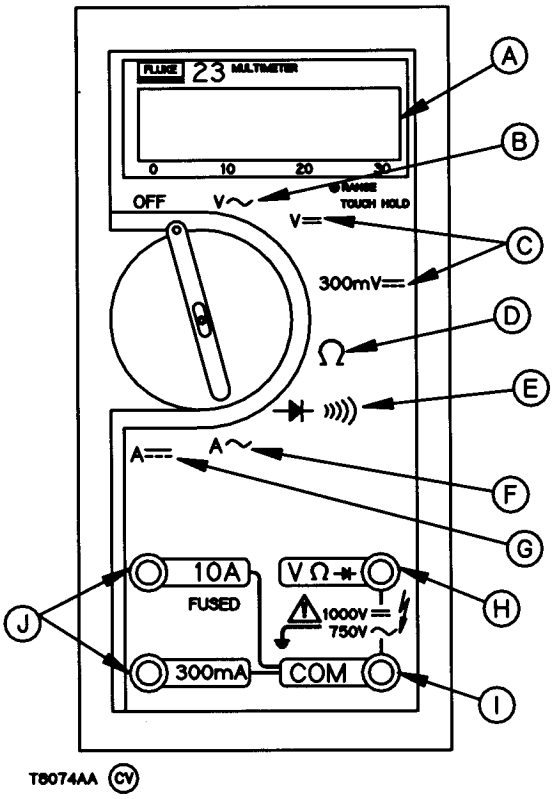
DPSG,OUO1004,666 –19–15MAR99–2/2

05
15
10

Multimeter

The multimeter is an autoranging digital display that allows very accurate readings to be taken.

A—Display
B—Voltage AC (Alternating Current)
C—Voltage DC (Direct Current)
D—Resistance
E—Diode Test/Continuity
F—Current AC (Alternating Current)
G—Current DC (Direct Current)
H—Voltage, Resistance, Diode/Continuity (Red Lead Input)
I—Ground (Black Lead Input)
J—Current/Amps (Red Lead Input)



DPSG,OUO1004,665 –19–15MAR99–1/1

Section 10
Delco-Remy Alternators

Contents

Delco-Remy (Delcotron) Alternator Operation

The drawing at right shows alternator circuitry. Schematic of regulator (E) has been simplified. The regulator is a non-adjustable, sealed, solid-state unit mounted inside the alternator.

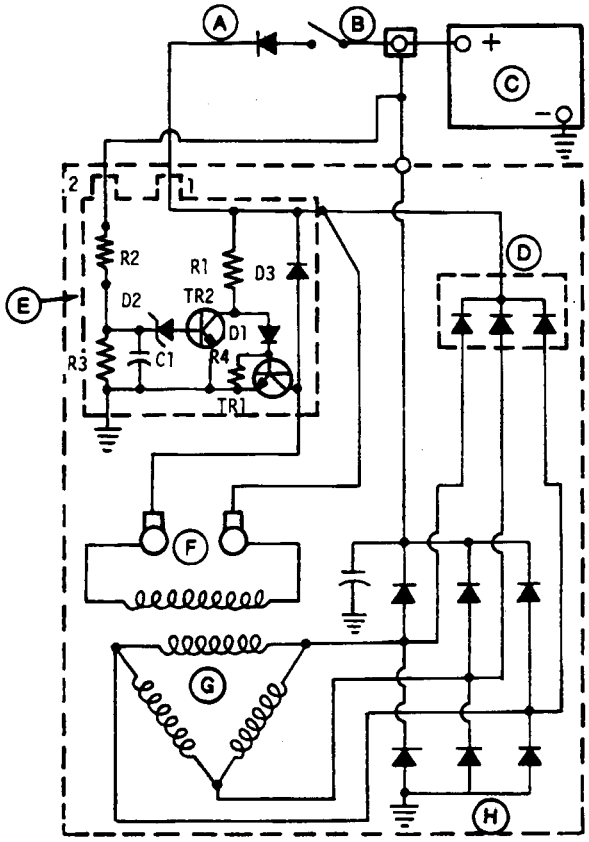
NOTE: To prevent battery run-down, R3 resistor has extremely high resistance. It still allows a constant drain on battery but this is insignificantly small. R3 and R4 are needed to provide voltage differential for turning on transistors.

An alternator (unlike a generator) uses a rotating magnetic field with stationary windings. The magnetic field is externally excited. This means that it requires an outside current source. The rotor (F) consists of two interlocking soft iron sections and a wire coil wrapped around an iron core. When current is passed through the wire coil, the rotor becomes an electromagnet.

The rotating magnetic field induces an alternating current in the stator windings (G). This is converted to direct current by six diodes in the rectifier bridge (H).

A capacitor inside rear housing protects rectifier bridge and diode trio (D) from voltage surges. It also suppresses radio interference.

This alternator uses an “A” field circuit with regulator located after field. Full output is obtained by grounding field.



Delco-Remy (Delcotron) Alternator

A—Diode
B—Switch
C—Battery
D—Diode Trio
E—Regulator
F—Rotor (Field)
G—Stator
H—Rectifier Bridge

RG,RG34710,2025 –19–15MAR97–1/1

Delco-Remy (Delcotron) Regulator Operation

The solid-state regulator is mounted inside the alternator. It controls output by controlling current through field. In operation, regulator has the following three phases.

Continued on next page

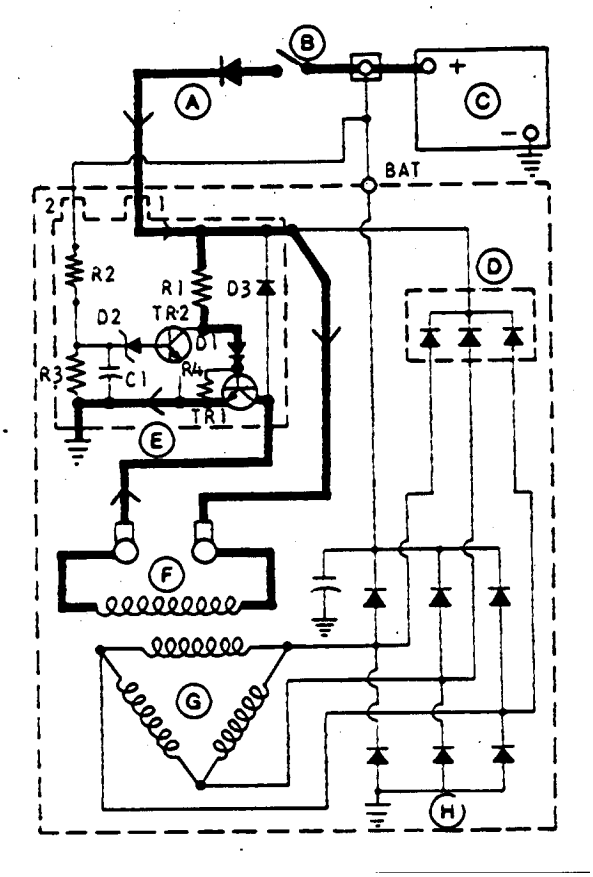
RG,RG34710,2026 –19–18OCT00–1/4

Phase I—Alternator Stopped

(Phase 1 also applies when alternator is running but only if not running fast enough for output to exceed battery voltage.)

1. Current flows from battery through key switch (B) and diode (A) to terminal 1.
2. From there, current flows through resistor R1 to transistor TR1 and turns it on.
3. Transistor TR1 then provides a path to ground so current can flow through field, enabling alternator to generate electricity.
4. Zener diode D2 prevents flow of current from terminal 2 to transistor TR2. A Zener diode is a special type of diode which will not permit current to pass until voltage reaches a certain preset level. If voltage exceeds that level, current can pass through the Zener diode.

A—Diode
B—Key Switch
C—Battery
D—Diode Trio
E—Regulator
F—Rotor (Field)
G—Stator
H—Rectifier Bridge

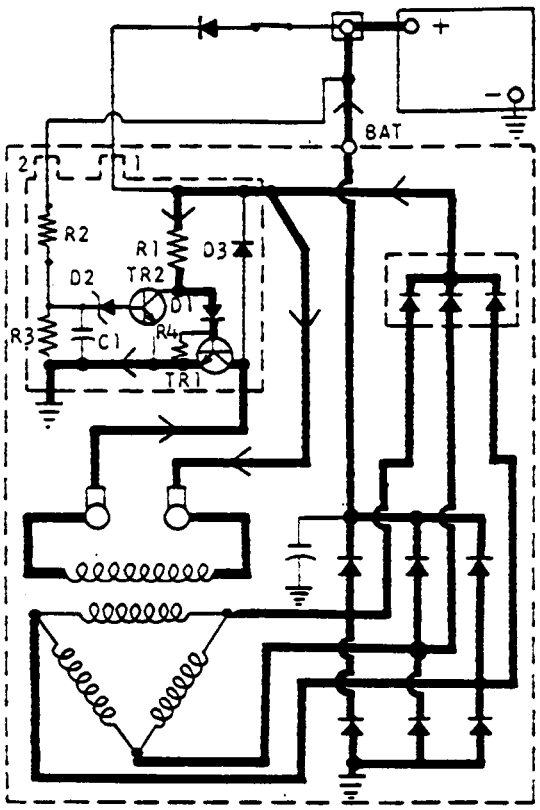


Phase I—Alternator Stopped

Continued on next page

Phase II—Generating Electricity

1. The diode trio, key switch, rectifier bridge, and terminal 1 all have equal voltage. Therefore no current flows through diode.
2. Current, now coming from diode trio, still flows through resistor R1 to turn on transistor TR1.
3. Transistor TR1 still provides a path to ground so current can flow through field, enabling alternator to generate electricity.
4. Since the field is rotating, it does generate electricity. Alternating current is included in the stator windings. The rectifier bridge converts it to direct current, providing current to run electrical accessories and charge batteries.
5. Output voltage still has not reached critical voltage of Zener diode D2, so no current can flow from terminal 2 to transistor TR2.



RW10108L –19–28NOV89

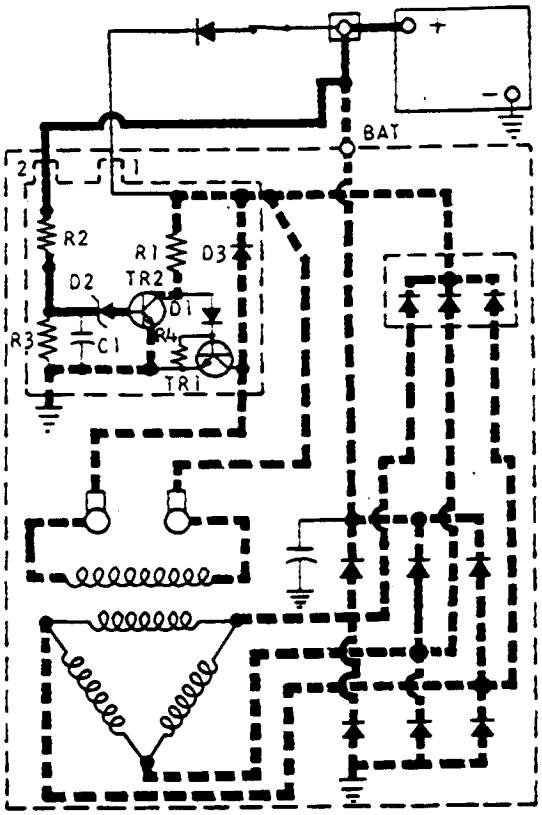
Phase II—Generating Electricity

Continued on next page

RG,RG34710,2026 –19–18OCT00–3/4

Phase III—Shut-Off

1. Output voltage reaches critical voltage of Zener diode D2.
2. Current can now pass through Zener diode D2 to turn on transistor TR2.
3. Transistor TR2 now provides a direct path to ground for any current coming through resistor R1.
4. This cuts off the current to transistor TR1, turning it off. There is now no path to ground for current through field.
5. Current through field is shut off instantly, and alternator stops generating electricity.
6. Phase II and III are repeated many times per second to maintain voltage at proper level.



RW10131L –19–28NOV89

Phase III—Shut-Off

RG,RG34710,2026 –19–18OCT00–4/4

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B4E –19–25APR02–1/5

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUO1004,0000B4E –19–25APR02–2/5

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000B4E –19–25APR02–3/5

RG12198 –UN–17JUL02

Alternator Pulley Tool Set JD306A

Remove and install alternator pulley retaining nut.

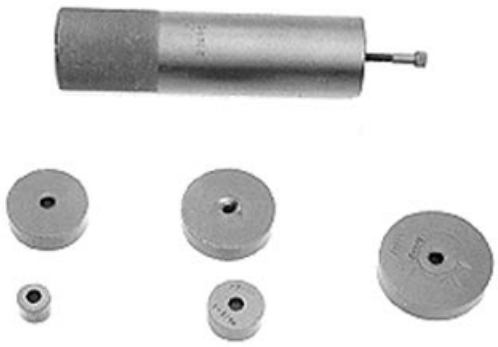
JD306A

Continued on next page

OUO1004,0000B4E –19–25APR02–4/5

Bushing, Bearing and Seal Driver Set D01045AA

Remove front bearing.



RG11162 –UN–21SEP00

D01045AA

OUO1004,0000B4E –19–25APR02–5/5

Other Material

Number	Name	Use
	Delco-Remy Lubricant No. 1948791	Lubricate alternator bearings.
	400-Grit Silicon Carbide Paper or 00 Sandpaper	Polish slip rings.

OUO1004,0000B50 –19–21SEP00–1/1

Delco-Remy (Delcotron) 10SI, 12SI, and 15SI Charging Circuit Repair Specifications

Item	Measurement	Specification
Delco-Remy Model 12SI Alternator Pulley Nut	Torque	100 N•m (75 lb-ft)
Delco-Remy Model 10SI and 15SI Alternator Pulley Nut	Torque	80 N•m (60 lb-ft)

OUO1004,0000B51 –19–21SEP00–1/1

Delco-Remy (Delcotron) 10SI, 12SI, and 15SI Charging Circuit Test Specifications

				Field Current @27°C (80°F)		Cold Output				Rated (Hot) Output at Rated Speed
John Deere Alternator Part No.	Delcotron Alternator Model No.	Series	Type	Amps	Volts	Amps	RPM	Amps	RPM	Amps
AR54793	1100490	10SI	106	4.0—4.5	12	25	2500	65	5000	72
AR54796	1104901	10SI	106	4.0—4.5	12	25 30 22	2000	51	5000	55
AR56728	1102359	10SI	106	4.0—4.5	12	22	2000	33	5000	37
AR84305	1102926	10SI	116	4.0—5.0	12	30	2000	57	5000	61
AR84306	1102932	10SI	116	4.0—5.0	12	25	2000	65	5000	72
AR93445	1103124	10SI	116	4.0—5.0	12	30	2000	57	5000	61
AR93446	1103128	10SI	116	4.0—5.0	12	25	2000	65	5000	72
AT117390	1105539	15SI	116	4.0—5.0	12	56	2000	110	5000	105
AT130930	1101285	10SI	100	1.2—1.6	24	25	2600	41	7000	40
AT142267	10479850	12SI	100	4.0—5.0	12	51	2000	81	7000	78
AT157177	10480058	10SI	116	4.0—5.0	12	51	2000	81	7000	78
AT157178	10480060	10SI	116	1.2—1.6	24	25	2600	41	7000	40
AT58321	1102936	10SI	116	4.0—5.0	12	30	2000	57	5000	61
AT64718	1103131	10SI	116	4.0—5.0	12	28	2000	42	7000	42
RE13797	1105175	10SI	116	4.0—5.0	12	25	2000	65	5000	72
RE13966	1105068	10SI	116	4.0—5.0	12	30	2000	57	5000	61
RE17379	1105422	10SI	116	4.0—5.0	12	32	2000	60	5000	63
RE20034	1105510	10SI	116	4.0—5.0	24	25	2600	41	7000	40
RE27109	1101268	12SI	100	4.2—5.0	12	30	1600	75	6500	75
RE31694	1101345	12SI	100	4.2—5.0	12	30	1600	78	6500	78
RE501112	19009950	19SI	—	—	12	—	—	110	—	105

Regulator Temperature[a]	Voltage
29°C (85°F)	13.8—14.9 volts
41°C (105°F)	13.6—14.7 volts
52°C (125°F)	13.4—14.6 volts
63°C (145°F)	13.2—14.4 volts
[a]Measured 25.4 mm (1.0 in.) from regulator.	

Continued on next page

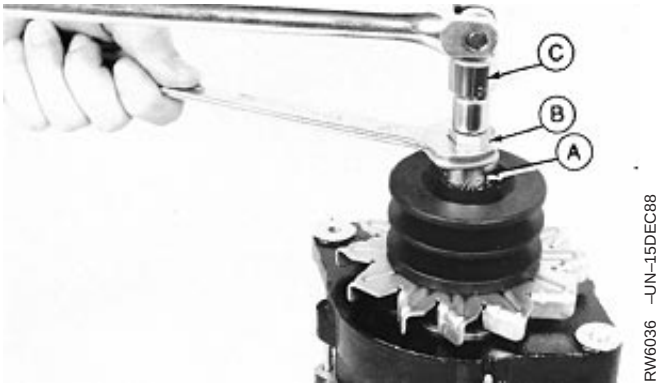
Stator Winding	Field Resistance
37-amp, 12-volt	0.23 ohm
40-amp, 24-volt	0.23 ohm
42-amp, 12-volt	0.28 ohm
55-amp, 12-volt	0.20 ohm
61-amp, 12-volt	0.20 ohm
63-amp, 12-volt	0.20 ohm
72-amp, 12-volt	0.10 ohm
75-amp, 12-volt	0.10 ohm
78-amp, 12-volt	0.10 ohm
105-amp, 12-volt	0.10 ohm
130-amp, 12-volt	0.04 ohm

RG,RG34710,2031 –19–07JUL05–2/2

Remove Pulley Nut

NOTE: Pulley nut need not be removed if you are certain that front bearing is in good condition. Separate housing as described and leave rotor in front housing.

1. Install a 15/16 in. socket (A) on JD306A-1 Alternator Pulley Nut Tool (B) to hold nut.
2. Install JD306A-2 (C) on hex shaft of JD306A-1 to hold rotor shaft.
3. Hold rotor and remove nut.



RW6036 –UN–15DEC88

Remove Pulley Nut

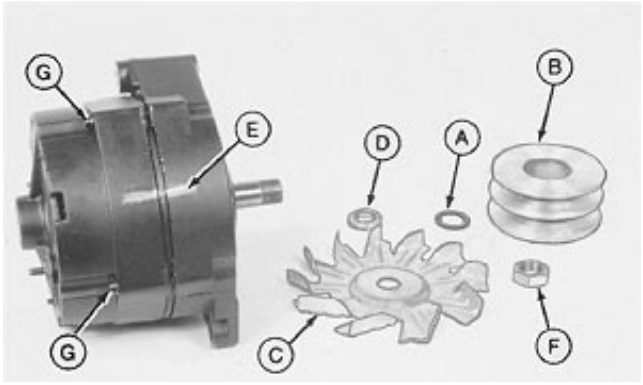
A—15/16 in. Socket
B—JD306A-1 Alternator Pulley Nut Tool
C—JD306A-2 Alternator Pulley Nut Tool

RG,RG34710,2032 –19–12SEP02–1/1

Separate Housing

1. Remove washer (A), pulley (B), fan (C), and collar (D).
2. Before separating, make a chalk mark (E) across separation between front and rear housings for alignment when reassembling. Housings can be indexed any one of four ways.

A—Washer
B—Pulley
C—Fan
D—Collar
E—Chalk mark
F—Nut
G—Through Bolts



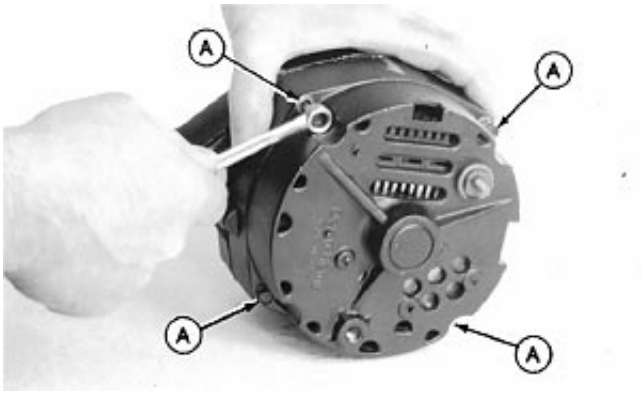
RW10657 –UN–16NOV89

Separate Housing

RG,RG34710,2033 –19–15MAR97–1/3

3. Remove four through bolts (A).
4. Separate front and rear housings. If necessary, pry carefully with two screwdrivers on opposite sides to force housings apart.

A—Through Bolts (4 Used)



RW6011 –UN–22FEB90

Separate Front and Rear Housing

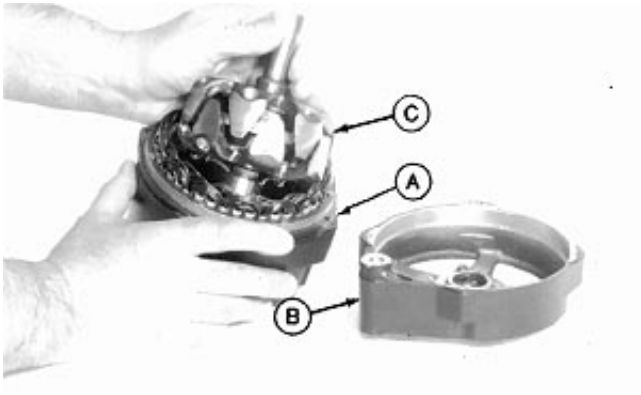
Continued on next page

RG,RG34710,2033 –19–15MAR97–2/3

5. Set alternator on rear housing (A) and slide front housing (B) off. Lift out rotor (C).

6. Place a piece of masking tape over rear bearing to keep trash out.

A—Alternator Rear Housing
B—Alternator Front Housing
C—Rotor



RW6012 –UN–22FEB90

Lift Out Rotor

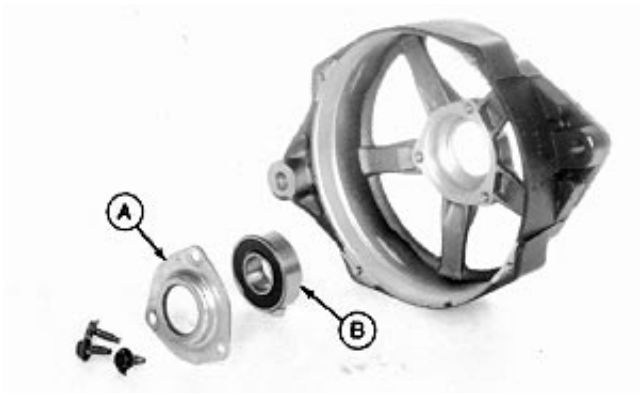
RG,RG34710,2033 –19–15MAR97–3/3

Remove Front Bearing

Remove bearing retainer (A) and bearing (B).

NOTE: If bearing must be pressed in or out of housing, carefully support housing near bearing diameter. A 1-3/4 in. socket makes a suitable support. Use disk No. 27494 from D01045AA Bushing Driver Set to press on inner diameter of bearing. Press from outside to inside.

A—Bearing Retainer
B—Bearing



RW6013 –UN–22FEB90

Remove Bearing Retainer and Bearing

RG,RG34710,2034 –19–15MAR97–1/1

Install Front Bearing

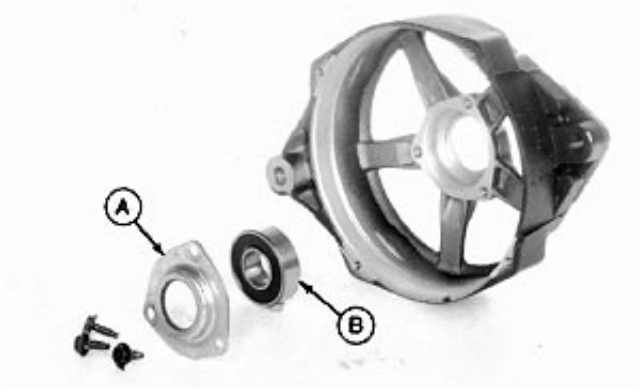
Bearing may be reused if not damaged.

1. Clean bearing and fill it 1/4 full with Delco-Remy Lubricant No. 1948791 before assembly. Do not overfill.

NOTE: Lubrication is not required on sealed bearings.

2. Install bearing (B).

A—Bearing Retainer
B—Bearing



RW6013 –UN–22FEB90

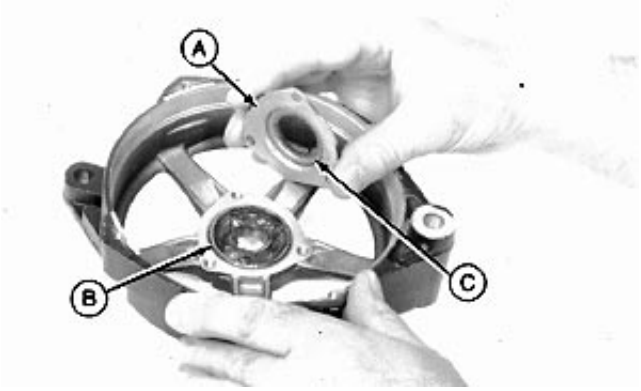
Install Front Bearing

RG,RG34710,2035 –19–12SEP02–1/2

3. Fill cavity between retainer plate (A) and bearing (B) with Delco-Remy No. 1948791 Lubricant.

4. If felt seal (C) is hardened or worn, replace seal and retainer.

A—Retainer Plate
B—Bearing
C—Felt Seal



RW6014 –UN–22FEB90

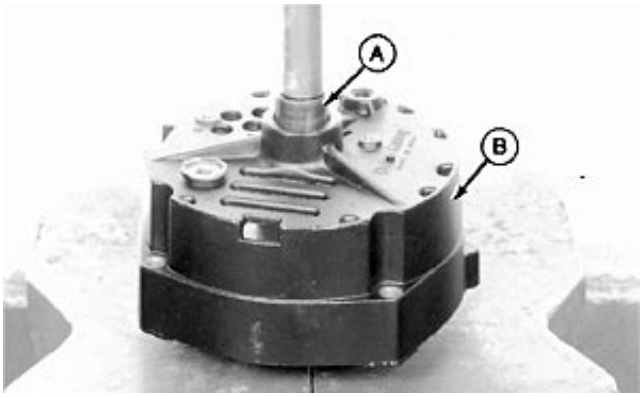
Replace Retainer

RG,RG34710,2035 –19–12SEP02–2/2

Remove and Install Rear Bearing

1. Replace rear bearing (A) if defective or its grease supply is exhausted. Do not relubricate.
2. Support housing (B) near bearing diameter with a 1-1/4 in. socket and press bearing to inside.
3. Press new bearing in until flush with housing.

NOTE: If seal is separate from bearing, install a new seal whenever bearing is replaced. Install seal with lip of seal toward rotor when assembled. Coat seal lip with oil when installing rotor shaft.



RW6015 –UN–22FEB90

Rear Bearing

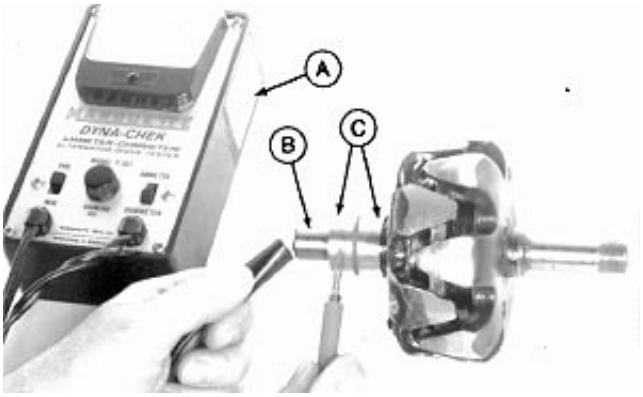
A—Rear Bearing
B—Support Housing

RG,RG34710,2036 –19–18OCT00–1/1

Test Rotor for Grounds

1. Use an ohmmeter (A) or test lamp to test for continuity.
2. Attach ohmmeter to rotor shaft (B) and each slip ring (C).
3. Replace rotor if test shows continuity.

A—Ohmmeter
B—Rotor Shaft
C—Slip Ring



RW6017 –UN–10NOV88

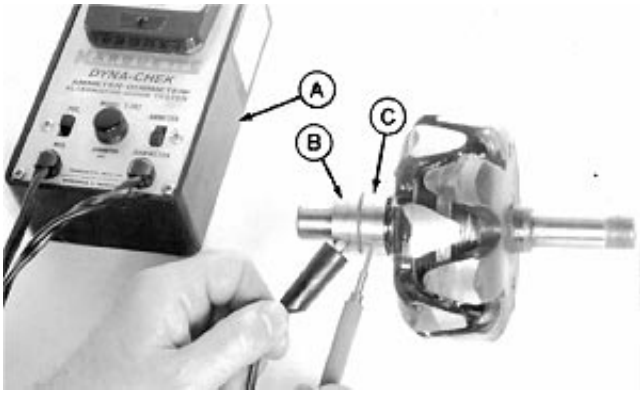
Test Rotor for Grounds

RG,RG34710,2038 –19–15MAR97–1/1

Test Rotor for Open Circuit

1. Use ohmmeter (A) (or test lamp) to test for continuity from one slip ring (B) to the other (C).
2. If test does not show continuity, replace rotor.

A—Ohmmeter
B—Slip Ring
C—Slip Ring



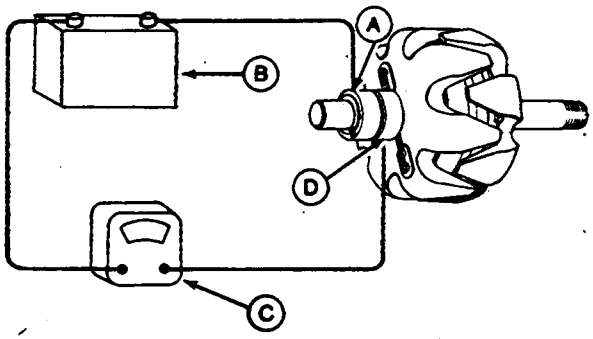
RW6018 –UN–10NOV88

Test Rotor for Open Circuit

RG,RG34710,2039 –19–15MAR97–1/1

Test Rotor for Short Circuit

1. Connect slip ring (A) to one terminal of 12-volt battery (B).
2. Connect ammeter (C) to other terminal of battery and slip ring (D).
3. Current draw should be 4.0—4.5 amps at 12 volts. Excessive current draw indicates a short circuit. Replace rotor if current draw exceeds 5.0 amps.



RW6019 –UN–25APR89

Test Rotor for Short Circuit

A—Slip Ring
B—12-Volt Battery
C—Ammeter
D—Slip Ring

RG,RG34710,2040 –19–18OCT00–1/1

Repair Slip Rings

NOTE: Rough or out-of-round slip rings can cause short brush life.

10
10
10

1. Mount rotor assembly on plate.
2. If slip rings are rough or scored, turn them just enough to eliminate roughness. If slip rings are out-of-round, turn them to within 0.005 mm (0.002 in.) of total indicator reading.
3. Polish slip rings sparingly with No. 00 sandpaper or 400-grit silicon carbide paper.

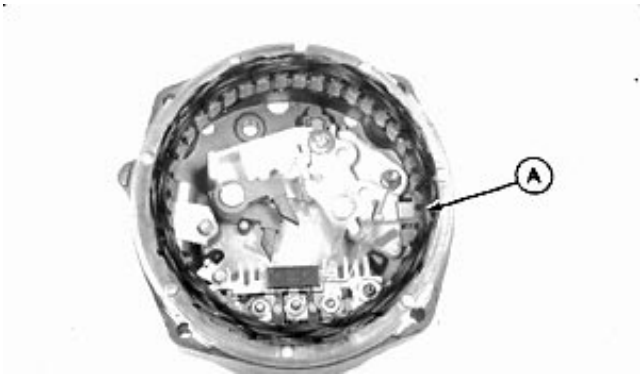
IMPORTANT: Clean rotor and stator with compressed air only. Cleaning solvent will damage insulation.

RG,RG34710,2041 –19–15MAR97–1/1

Inspect Stator

1. Inspect stator (A) for defective insulation.
2. Check for discoloration or a burned odor indicating a short circuit.
3. Replace stator if you find any defect.

A—Stator



Inspect Stator

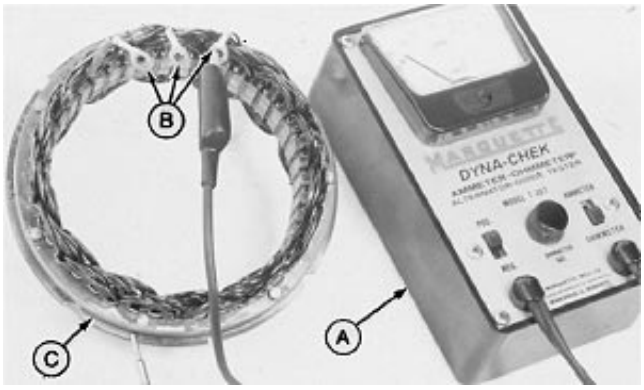
RG,RG34710,2042 –19–15MAR97–1/1

Test Stator for Grounds

Connect an ohmmeter (A) (or test lamp) between each stator (B) lead and stator frame (C). Replace stator if test indicates continuity.

NOTE: The stator cannot be tested for an open circuit unless terminals are disconnected from stator windings.

A—Ohmmeter
B—Stator
C—Stator Frame



RW10652 –UN–16NOV89

Test Stator for Grounds

RG,RG34710,2043 –19–15MAR97–1/1

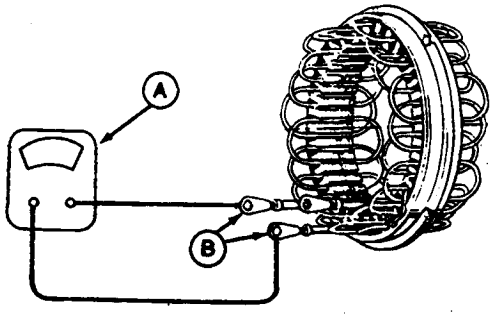
Test Stator for Short Circuit

A short-circuit in the stator can be difficult to identify. Use an ohmmeter that is sensitive to resistance of 0.0 to 1.0 ohm.

Connect ohmmeter (A) between each pair of terminals (B). Resistance should be approximately 0.1 ohm. (Ohmmeter needle should deflect to zero if leads are touched together.) If resistance is low, windings are shorted and must be replaced.

A stator will occasionally exhibit an open circuit or short circuit only when hot, making the defect even more difficult to diagnose.

If a stator defect cannot be confirmed, re-check all other components. If problem is not found elsewhere, replace stator.



RW6022 –UN–25APR89

Connect Ohmmeter Between Terminals

A—Ohmmeter
B—Terminals

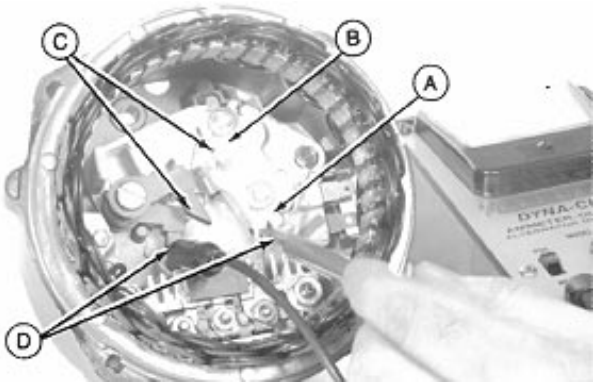
RG,RG34710,2044 –19–15MAR97–1/1

Test Brush Assembly for Grounds

A grounded brush assembly results in either no output or uncontrolled output, depending on where the ground is located.

NOTE: A grounded brush assembly may also damage the diode trio. Before assembling alternator, check diode trio.

1. Check insulating washers on screws holding brush leads (A and B). Replace if necessary. If circuit is grounded elsewhere, replace regulator.
2. Connect ohmmeter (or test lamp) between points (B and C) and between points (A and D). Replace brush assembly if either check shows no continuity.



Test Brush Assembly for Grounds

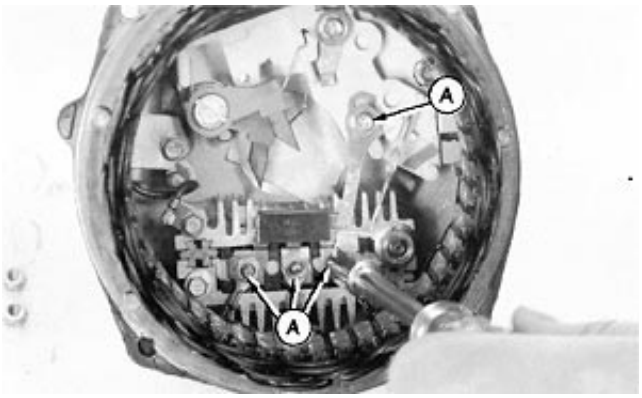
A—Brush Contact from Diode Trio
B—Brush Contact from Regulator
C—Test Point
D—Test Point

RG,RG34710,2045 –19–15MAR97–1/1

Test Diode Trio

1. Remove stator and diode trio attaching nuts (A). Note position of any insulating washers.
2. Remove diode trio, noting insulator position.

A—Stator and Diode Trio Attaching Nuts (4 Used)



Stator and Diode Trio

Continued on next page

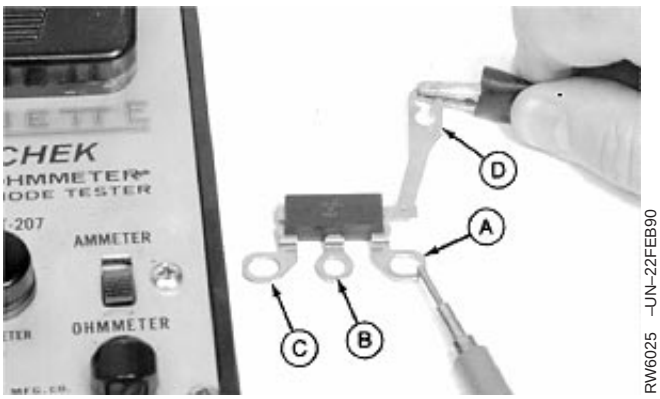
RG,RG34710,2046 –19–15MAR97–1/2

3. Connect ohmmeter (or test lamp) to points (A and D). Check for continuity. Reverse leads and test for continuity between same points. A good diode trio will have continuity only in one direction.

   Repeat test between points (B and C) and (C and D).

   Replace diode trio unless tests show continuity in only one direction in each case.

A—Terminal
B—Terminal
C—Terminal
B—Terminal



RW6025 –UN–22FEB90

Connect Ohmmeter

RG,RG34710,2046 –19–15MAR97–2/2

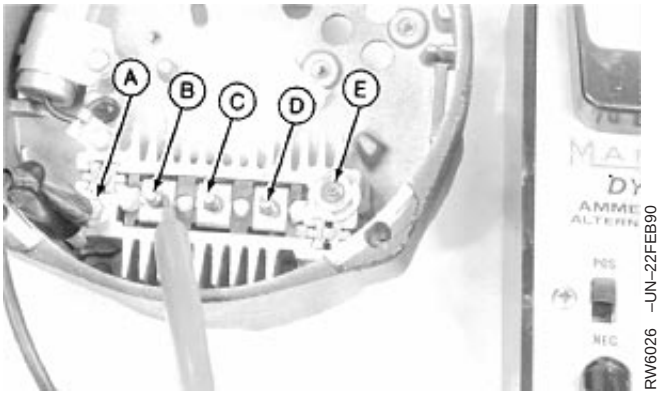
Test Rectifier Bridge

NOTE: Rectifier bridge has grounded heat sink (A) and insulated heat sink (E).

Connect ohmmeter (or test lamp) to points A and B. Then reverse leads between same two points. Continuity should be in only one direction.

NOTE: On models 10-SI and 12-SI, connect ohmmeter lead to threaded stud of test points (B), (C), and (D). On all other models, connect ohmmeter by pressing down very firmly onto flat metal connector, and not onto threaded stud.

A—Grounded Heat Sink
B—Terminal
C—Terminal
D—Terminal
E—Insulated Heat Sink



RW6026 –UN–22FEB90

Test Rectifier Bridge

RG,RG34710,2047 –19–15MAR97–1/1

Regulator Test

Regulator cannot be effectively tested. Replace regulator if brush assembly tests indicate a failure.

RG,RG34710,2048 –19–15MAR97–1/1

Assemble the Alternator

1. Install rectifier bridge (A). Be sure insulating washers are in position.

A—Rectifier Bridge

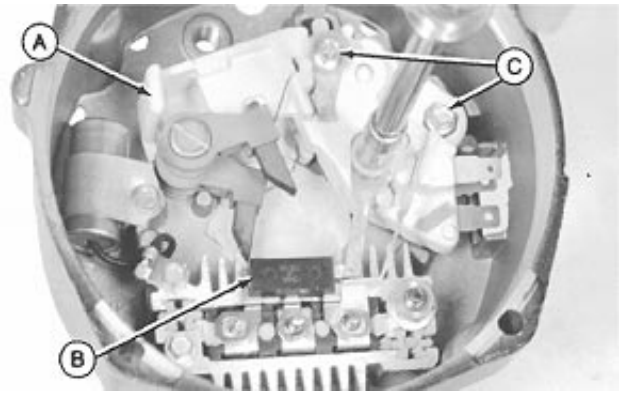
Install Rectifier Bridge

RG,RG34710,2049 –19–15MAR97–1/4

2. Install brush assembly (A) and diode trio (B). Be sure brush assembly insulating screws (C) are in position.

3. Push brushes back to clear slip rings. Insert a wire through hole in rear housing only far enough to hold brushes back.

A—Brush Assembly
B—Diode Trio
C—Brush Assembly Insulating Screws (2 Used)



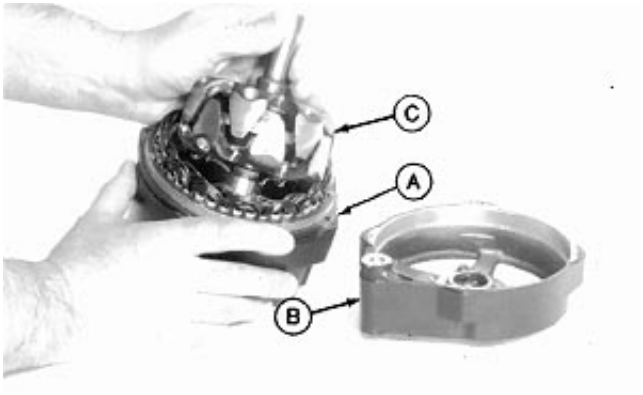
Install Brush Assembly and Diode Trio

Continued on next page

RG,RG34710,2049 –19–15MAR97–2/4

4. Remove tape over rear bearing and carefully slip rotor (C) into rear housing (A).

A—Rear Housing
B—Front Housing
C—Rotor



RW6012 –UN–22FEB90

Slip Rotor into Rear Housing

RG,RG34710,2049 –19–15MAR97–3/4

5. Carefully slip front housing over rotor shaft. Align previously marked chalk mark (E).

6. Install four through bolts (G). Alternately tighten bolts until secure.

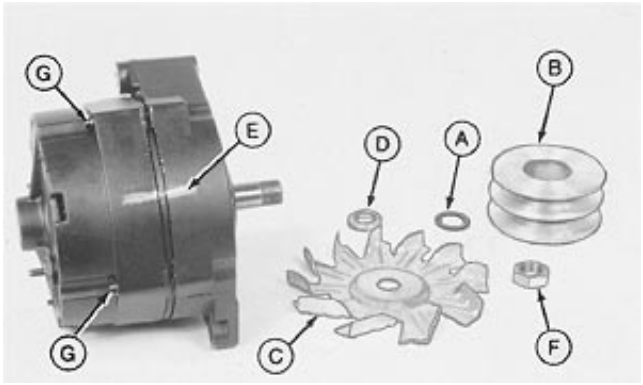
7. Remove wire from housing.

8. Install collar (D), fan (C), pulley (B), washer (A) and nut (F). Tighten pulley nut with JD306A Alternator Pulley Tool to specifications.

Specification

Delco-Remy Model 12SI Alternator Pulley Nut—Torque	100 N•m (75 lb-ft)
Delco-Remy Model 10SI and 15SI Alternator Pulley Nut—Torque	80 N•m (60 lb-ft)

.



RW10657 –UN–16NOV89

Slip Front Housing Over Rotor Shaft

A—Washer
B—Pulley
C—Fan
D—Collar
E—Chalk Mark
F—Nut
G—Bolts

RG,RG34710,2049 –19–15MAR97–4/4

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B52 –19–21SEP00–1/3

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUO1004,0000B52 –19–21SEP00–2/3

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000B52 –19–21SEP00–3/3

Delco-Remy (Delcotron) 21SI Charging Circuit Repair Specifications

Item	Measurement	Specification
Delco-Remy Model 21SI Alternator Pulley Nut	Torque	100 N•m (75 lb-ft)
Drive End Bearing Retainer Plate Cap Screws	Torque	3.0 N•m (26 lb-in.)
Slip Ring End Housing Components		
Inside Output Terminal Nut	Torque	5.5 N•m (50 lb-in.)
Rectifier Bridge Attaching Screws	Torque	3.0 N•m (25 lb-in.)
Capacitor Attaching Screw	Torque	2.5 N•m (22 lb-in.)
“R” Terminal Nut	Torque	2.5 N•m (22 lb-in.)
Regulator Mounting Screws	Torque	2 N•m (20 lb-in.)
Regulator Mounting Nut	Torque	2.5 N•m (22 lb-in.)
Brush Holder Pivot Attaching Screw	Torque	2 N•m (20 lb-in.)
Stator Debris Shield Mounting Stud Nut	Torque	5.5 N•m (50 lb-in.)
Rectifier Bridge Nuts	Torque	2.5 N•m (22 lb-in.)
Drive End-to-Slip Ring End Housing Through Bolts	Torque	5.5 N•m (50 lb-in.)

OUO1004,0000BB1 –19–28SEP00–1/1

Delco-Remy (Delcotron) 21SI Charging Circuit Test Specifications

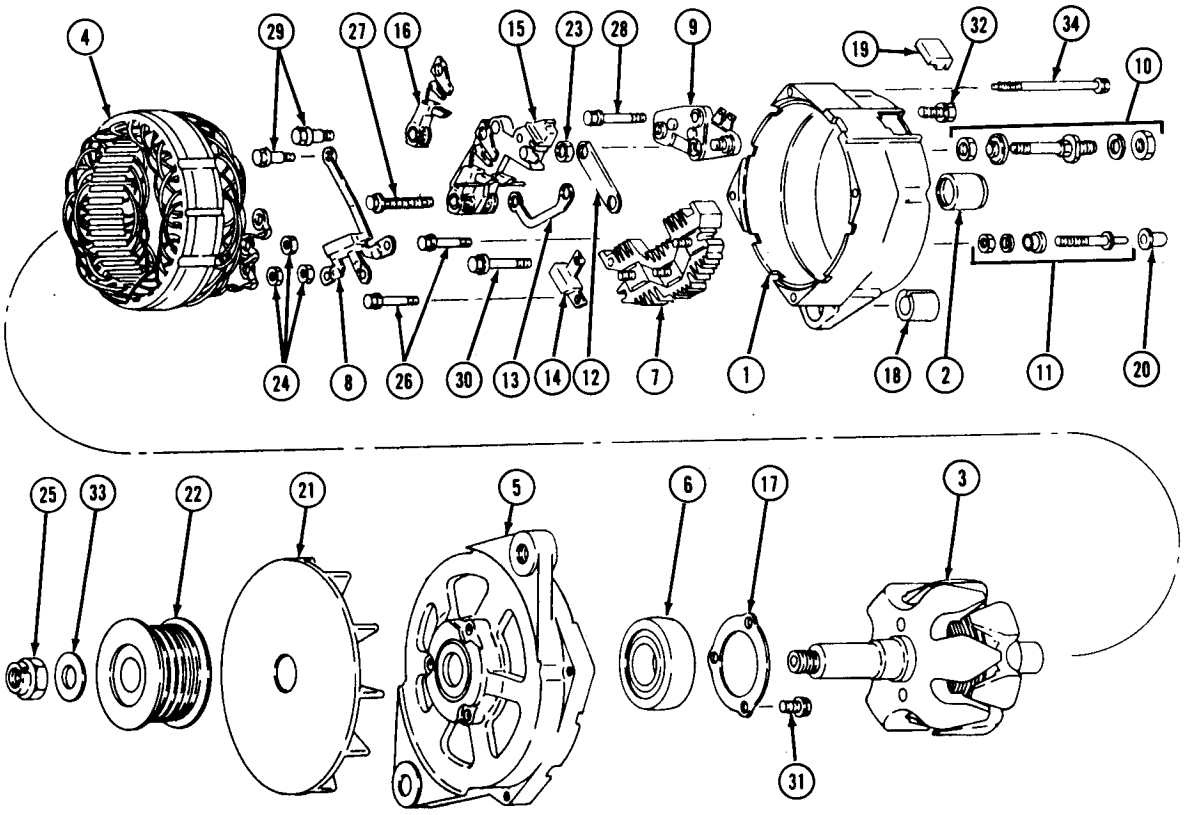
				Field Current @ 27°C (80°F)		Cold Output				Rated (Hot) Output at Rated Speed
John Deere Alternator Model No.	Delcotron Alternator Model No.	Alternator Series	Type	Amps	Volts	Amps	RPM	Amps	RPM	Amps
AT142246	1117909	21SI	355	6.7—7.1	12	50	1600	130	5000	130

Regulator Temperature[a]	Voltage
29°C (85°F)	13.8—14.9 volts
41°C (105°F)	13.6—14.7 volts
52°C (125°F)	13.4—14.6 volts
63°C (145°F)	13.2—14.4 volts
[a]Measured 25.4 mm (1.0 in.) from regulator.	

Stator Winding Field	Resistance
130-amp, 12-volt	0.04 ohm

RG,RG34710,2052 –19–07JUL05–1/1

Disassemble Delco-Remy 21SI Alternator



Delco-Remy 21SI Alternator

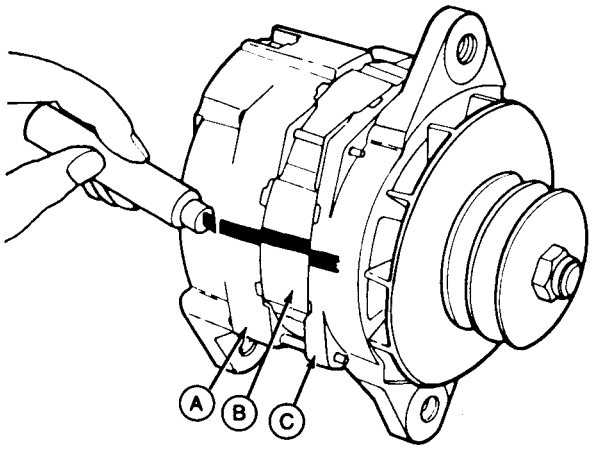
1—Slip Ring End Housing
2—Slip Ring End Bearing
3—Rotor Assembly
4—Stator Assembly
5—Drive End Frame
6—Drive End Bearing
7—Rectifier Bridge Assembly
8—Diode Trio
9—Regulator
10—BAT Terminal Assembly
11—"I" Terminal Assembly
12—Regulator Stud Connector
13—"I" Terminal Connector
14—Capacitor
15—Brush Holder Assembly
16—Brush and Arm
17—Drive End Retainer Plate
18—Hinge Bushing
19—Regulator Terminal Cover
20—Terminal Cap
21—Fan
22—Pulley
23—Regulator Nut
24—Rectifier Bridge Nut
25—Shaft Nut
26—Rectifier Bridge Nut/Washer Assembly
27—Brush Holder Attaching Screw (Pivot)
28—Regulator Attaching Screw (Ground)
29—Regulator Attaching Screw (Insulated)
30—Capacitor Attaching Screw
31—Bearing Retainer Plate Attaching Screw
32—Slip Ring End Frame Ground Screw and Load Washer
33—Shaft Nut Washer
34—Through Bolt

RG,RG34710,2053 –19–15MAR97–1/1

Disassemble Alternator

1. Place alignment mark across slip ring end housing (A), stator housing (B), and drive end frame (C) for assembly after repair.

A—Slip Ring End Housing
B—Stator Housing
C—Drive End Frame



RG6971 –UN–30NOV93

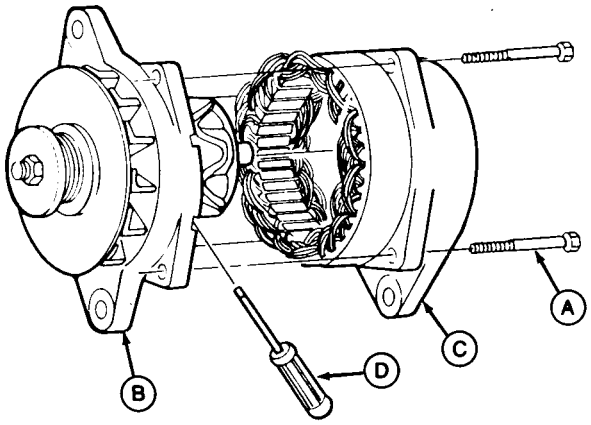
Alignment Mark

RG,RG34710,2054 –19–15MAR97–1/2

2. Remove four through bolts (A).

3. Separate drive end frame (B) (with rotor) from slip ring end housing (C) (with stator). If necessary, carefully pry drive end frame from edge of stator with screwdriver (D). After separation, place tape over slip ring end housing bearing inside unit to prevent dirt from entering bearing.

A—Through Bolts
B—Drive End Frame
C—Slip Ring End Housing
D—Screwdriver



RG6972 –UN–30NOV93

Disassemble Alternator

RG,RG34710,2054 –19–15MAR97–2/2

Slip Ring End Housing and Components

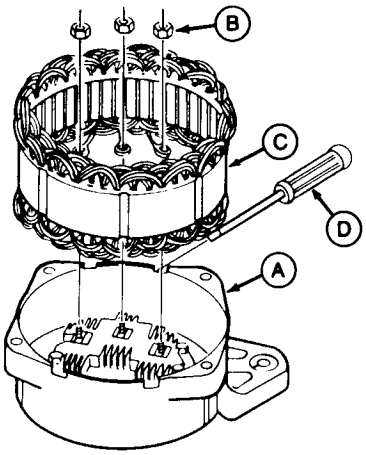
1. Inspect slip ring end housing (A) for loose connections or other obvious conditions. Correct as necessary. If none are found, proceed with slip ring end housing checks which follow.

2. Remove three rectifier bridge nuts (B) to disconnect stator (C). If necessary, carefully pry stator (C) away from slip ring end housing (A) with a screwdriver (D).

3. Inspect stator windings for dark, burned appearance. View windings from inside of unit; black paint on outside of windings does not indicate burned windings.

   If all windings are uniform in color and varnish covering is not flaking off, proceed with electrical check, step 4 below.

   If some windings are dark and others are light, a shorted, open, or grounded condition is indicated. Replace the stator. The stator should also be replaced if the windings are uniformly dark and burned, with the varnish flaking off to expose bare wires.



RG6973 –UN–30NOV93

Slip Ring End Housing and Components

A—Slip Ring End Housing
B—Rectifier Bridge Nuts
C—Stator
D—Screwdriver

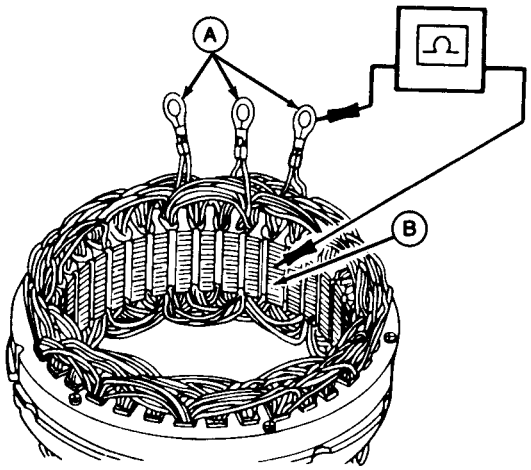
Continued on next page

RG,RG34710,2055 –19–18OCT00–1/7

4. Perform electrical check on stator. Use digital multimeter on ohms setting (or a 110-volt test lamp). There should be no continuity between any of the stator leads (A) and the stator laminations (B).

   If continuity is present, windings are grounded. Replace stator.

   If there is no continuity, stator is probably good. However, there is no service electrical check for shorted or open delta stator windings. If all other electrical checks are normal and the generator did not produce within 15 amps of the rated output, a shorted or open stator is indicated and the stator should be replaced.



RG6974 –UN–30NOV93

Stator Leads and Laminations

A—Stator Leads
B—Stator Laminations

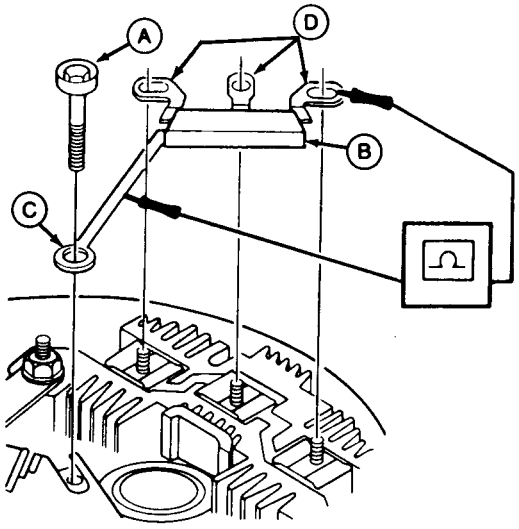
RG,RG34710,2055 –19–18OCT00–2/7

5. Remove insulated regulator attaching screw (A) to disconnect diode trio (B). Lift diode trio from slip ring end housing assembly.

6. Place the negative ohmmeter lead on regulator strap (C) and use positive ohmmeter lead to check for continuity to each of the three rectifier bridge straps. All three readings should indicate continuity. Reverse the ohmmeter leads and perform the checks again. Readings should all indicate open circuits.

   If all readings are proper, diode trio is good.

   If any reading is wrong, replace the diode trio.



RG6975 –UN–30NOV93

Check Continuity

A—Insulated Regulator Screws
B—Diode Trio
C—Regulator Strap
D—Rectifier Bridge Straps

Continued on next page

RG,RG34710,2055 –19–18OCT00–3/7

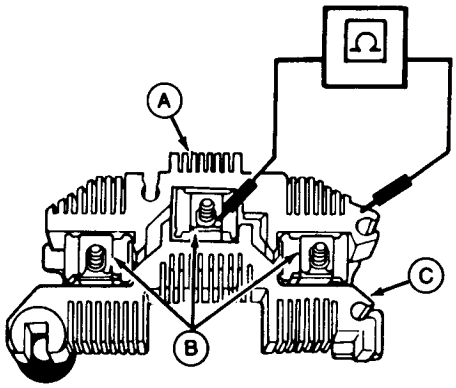
7. Use the digital multimeter to check the rectifier bridge. Rectifier bridge may also be checked while installed in the slip ring end housing. Check rectifier bridge as follows:

   Place negative ohmmeter lead on grounded heat sink (A). Touch positive ohmmeter lead firmly to metal diode clips (B) that surround each of the three threaded studs. All three readings should be the same and indicate open circuits. Reverse the ohmmeter leads and perform the checks again. All three readings should indicate continuity.

   Repeat checks using insulated (positive) heat sink (C) in place of grounded heat sink. With negative ohmmeter lead on insulated heat sink (C), all three readings should indicate continuity. Reverse the ohmmeter leads and perform the checks again. Readings should all indicate open circuits.

   If readings are good, the rectifier bridge is good.

   If any reading is wrong, an open or shorted diode is indicated and the rectifier bridge should be replaced.



RG6976 –UN–30NOV93

Check Rectifier Bridge

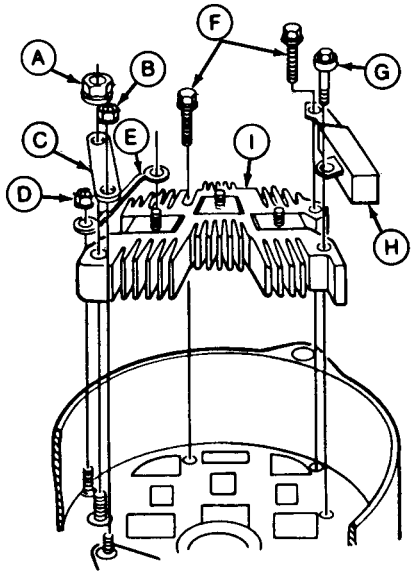
A—Grounded Heat Sink
B—Metal Diode Clips
C—Insulated (Positive) Heat Sink

Continued on next page

RG,RG34710,2055 –19–18OCT00–4/7

8. To remove rectifier bridge, remove inside BAT terminal nut (A), regulator nut (B) and regulator stud connector (C) from regulator stud. Remove inside “R” (relay) terminal nut (D) and relay terminal connector (E) (if used), two bridge attaching screws (F), and insulated capacitor attaching screw (G). Lift capacitor (H) and rectifier bridge (I) from slip ring end housing.

A—BAT Terminal Nut
B—Regulator Nut
C—Regulator Stud Connector
D—Relay Terminal Nut
E—Relay Terminal Connector
F—Bridge Attaching Screws
G—Capacitor Attaching Screw
H—Capacitor
I—Rectifier Bridge



RG6977 –UN–30NOV93

Remove Rectifier Bridge

Continued on next page

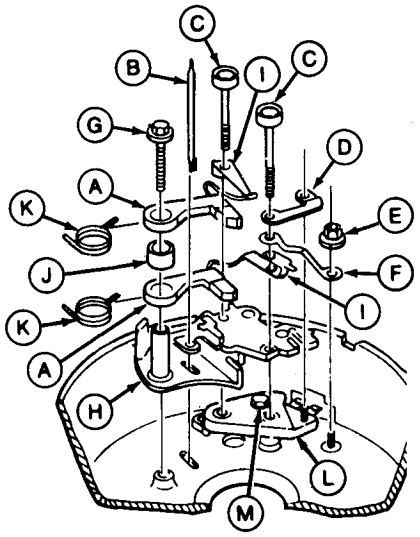
RG,RG34710,2055 –19–18OCT00–5/7

10
15
10

9. Brush holder assembly must be removed to service brushes or regulator. Hold brushes (A) in retracted position and insert brush pin (B) to keep brushes in retracted position. Remove insulated regulator attaching screws (C). Remove regulator nut and stud connector (D) (if used). Loosen or remove inside “I” terminal nut (E) to move “I” terminal connector (F) (if used) as necessary for clearance. Finally, remove brush holder pivot screw (G). Lift brush holder assembly (H) from housing without bending regulator connector from diode trio or “I” terminal connector.

10. Check brushes and leads for excessive wear, breakage, etc. If necessary to replace, note routing of lead wires and position of brush lead clips (I) for later assembly. (Brushes are identical but leads and clips are positioned differently.) Carefully remove brush pin (B) to release brushes (A). Remove brushes and spacer (J) one at a time, placing fingers around springs (K) to prevent loss. It may be necessary to spread the brush lead clips slightly to disengage retaining tabs.

11. If previous checks lead to an instruction to replace the regulator (L), replace it. Remove remaining regulator attaching (ground) screw (M).



RG6978 –UN–30NOV93

Brush Holder Assembly

A—Brush
B—Brush Pin
C—Regulator Attaching Screws
D—Regulator Stud Connector
E—Inside “I” Terminal Nut
F—“I” Terminal Connector
G—Brush Holder Pivot
H—Brush Holder Assembly
I—Brush Lead Clip
J—Spacer
K—Brush Springs
L—Regulator
M—Regulator Attaching Screw

Continued on next page

RG,RG34710,2055 –19–18OCT00–6/7

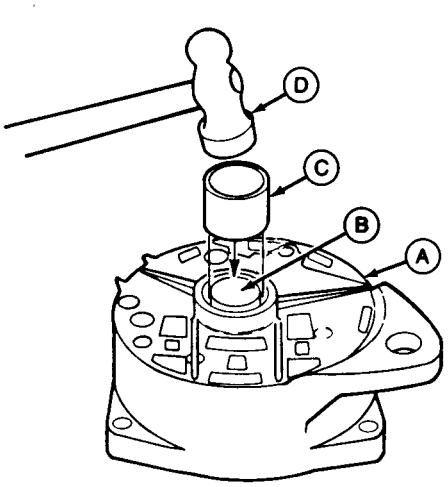
12. Remove protective tape and check bearing (B) in slip ring end housing (A). If bearing is dry or damaged, replace bearing.

NOTE: Bearings are permanently lubricated. Do not add grease.

To remove bearing, use tube (C) slightly smaller than opening in slip ring end housing and drive bearing through to inside of housing.

NOTE: If bearing is being replaced without removing brushes from slip ring end housing, use brush pin to hold brushes in retracted position while bearing is removed.

13. Place tape over bearing until reassembly of alternator.



RG6979 –UN–30NOV93

Check Bearing

A—Slip Ring End Housing
B—Slip Ring End Bearing
C—Tube
D—Hammer

RG,RG34710,2055 –19–18OCT00–7/7

Drive End Frame and Components

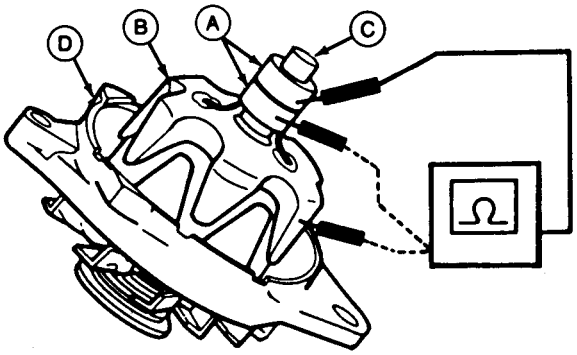
1. Use digital multimeter to check rotor field resistance. Place ohmmeter leads on two slip rings (A) on the rotor shaft to make this check. Proper resistance is 0.04 ohm.

   Also check for a grounded field by touching one lead to a slip ring and one lead to rotor frame (B) or shaft (C). Reading should be infinite (open) to show that field is not grounded.

   If field resistance is outside specifications, or if field is grounded, replace rotor as described in the following steps.

2. Hold drive end frame (D) and spin rotor by hand to see that it spins freely in ball bearing. If bearing movement is rough or loose, replace bearing in drive end frame as described in the following steps.

NOTE: Bearing is permanently lubricated. Do not add grease.



RG6980 –UN–30NOV93

Drive End Frame and Components

A—Slip Rings
B—Rotor Frame
C—Rotor Shaft
D—Drive End Frame

Continued on next page

RG,RG34710,2056 –19–15MAR97–1/2

10
15
12

3. Remove shaft nut (A) by placing a 5/16-in. hex wrench (B) in the end of the shaft to hold the shaft while removing nut with a common wrench (C). Remove shaft nut washer (D), pulley (E) and fan (F) from shaft.

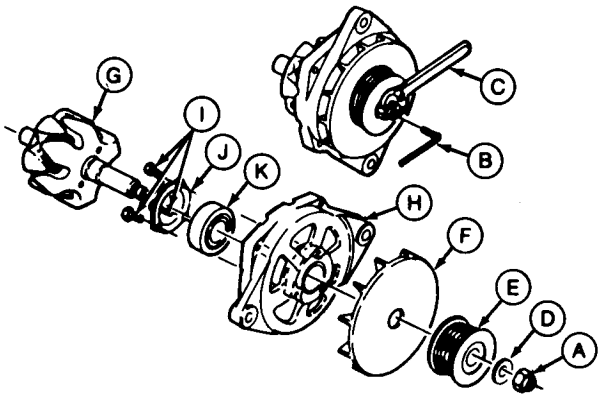
4. Remove rotor (G) from drive end frame (H).

5. If rotor checked good electronically, inspect slip rings. If rough or out of round, turn in lathe (removing only enough material to make rings smooth and round). Maximum indicator reading for roundness is 0.05 mm (0.002 in.). Finish with 400 grain polishing cloth. Blow away all copper dust. Clean shaft of any accumulated grease or copper dust.

6. Remove three attaching screws (I) and bearing retainer plate (J) from drive end frame.

7. Inspect drive end bearing (K). If bearing appears dry, or if rotor did not turn smoothly when checked during alternator disassembly, replace the drive end bearing.

NOTE: Bearing is permanently lubricated. Do not add grease.



RG6981 –UN–30NOV93

Inspect Bearing

A—Shaft Nut
B—Hex Wrench
C—Common Wrench
D—Shaft Nut Washer
E—Pulley
F—Fan
G—Rotor
H—Drive End Frame
I—Attaching Screws
J—Retainer Plate
K—Drive End Bearing

RG,RG34710,2056 –19–15MAR97–2/2

Assemble Alternator

1. Install drive end bearing (K) and bearing retainer plate (J) on drive end frame (H) with three attaching screws (I). Tighten attaching screws to specifications.

Specification

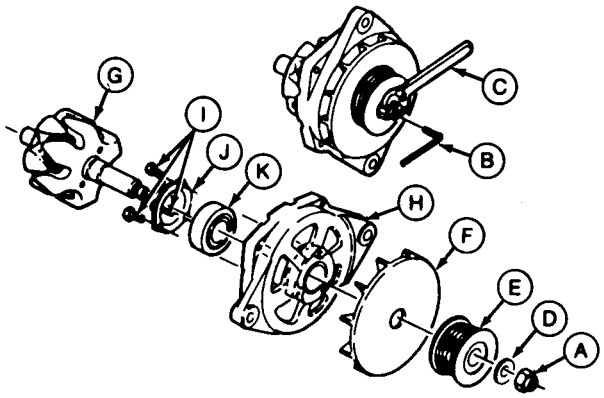
Drive End Bearing Retainer Plate
Cap Screws—Torque ..... 3.0 N•m (26 lb-in.)

2. Install rotor shaft (G) into drive end bearing.

3. Install fan (F), pulley (E) and shaft nut washer (D) and shaft nut (A) onto rotor shaft. Hold rotor shaft with 5/16-inch hex wrench (B) and tighten shaft nut with common wrench (C). Tighten shaft nut to specifications.

Specification

Delco-Remy Model 21SI
Alternator Pulley Nut—Torque ..... 100 N•m (75 lb-ft)



RG6981 –UN–30NOV93

Alternator Components

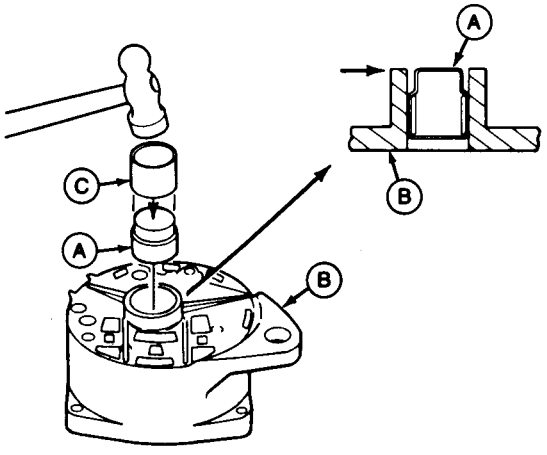
A—Shaft Nut
B—Hex Wrench
C—Common Wrench
D—Shaft Nut Washer
E—Pulley
F—Fan
G—Rotor
H—Drive End Frame
I—Attaching Screws
J—Retainer Plate
K—Drive End Bearing

RG,RG34710,2057 –19–15MAR97–1/1

Slip Ring End Housing Assembly

1. Install slip ring end bearing (A) into slip ring end housing (B) using appropriate size tube (C). Install bearing flush with outside lip of housing. Cover opening in bearing with tape to prevent entry of dirt.

A—Slip Ring End Bearing
B—Slip Ring End Housing
C—Tube



RG6982 –UN–30NOV93

Slip Ring End Housing Assembly

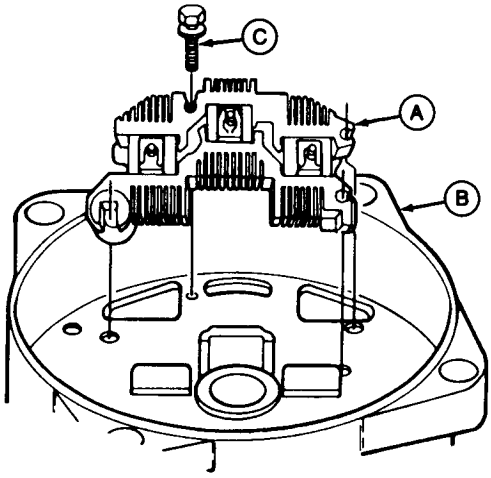
Continued on next page

RG,RG34710,2058 –19–06MAY02–1/10

10
15
14

2. Install rectifier bridge assembly (A) in slip ring end housing (B). Install one rectifier bridge attaching screw (C) through grounded heat sink portion of rectifier bridge as shown. Tighten attaching screw finger-tight.

A—Rectifier Bridge Assembly
B—Slip Ring End Housing
C—Rectifier Bridge Attaching Screw



RG6983 –UN–30NOV93

Install Rectifier Bridge Assembly

RG,RG34710,2058 –19–06MAY02–2/10

NOTE: Shape of "R" terminal connector determines location of "R" terminal in slip ring end housing.

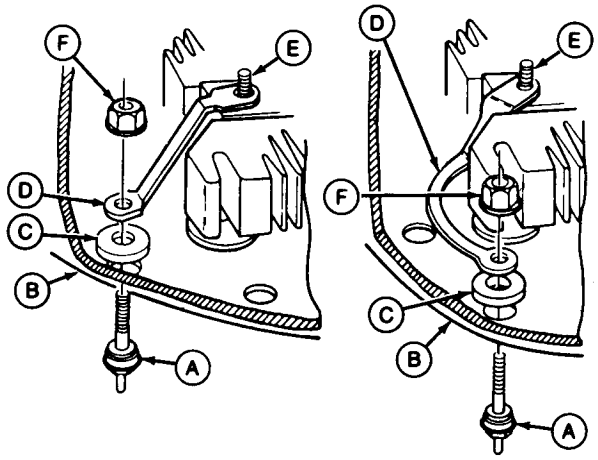
3. Install relay "R" terminal (A) in slip ring end housing (B). Place inside insulating washer (C) over "R" terminal stud. Place "R" terminal connector (D) over rectifier bridge stud (E) and "R" terminal stud.

NOTE: Be sure inside insulating washer is between connector and slip ring end housing at terminal end. Connector must not touch housing. Also be sure outside insulator is centered in hole to ensure that terminal stud cannot touch housing.

4. Install inside nut/washer assembly (F) on "R" terminal stud. Tighten inside nut/washer assembly to specifications.

Specification

"R" Terminal Stud Nut—Torque ..... 2.5 N•m (22 lb-in.)



RG6984 –UN–30NOV93

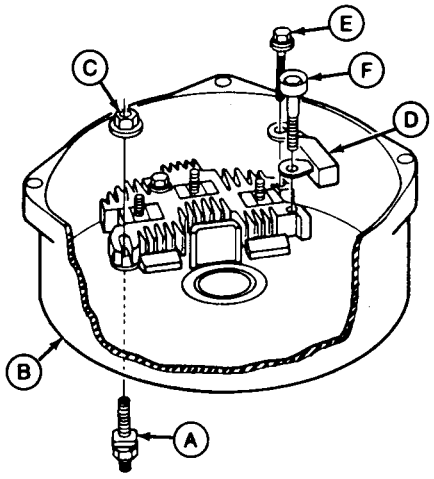
Install Terminal Connectors

A—"R" Terminal
B—Slip Ring End Housing
C—Insulating Washer
D—"R" Terminal Connector
E—Rectifier Bridge Stud
F—Inside Nut/Washer Assembly

Continued on next page

RG,RG34710,2058 –19–06MAY02–3/10

5. Install output (BAT) terminal (A) on slip ring end housing (B). Be sure to seat square insulator flange in hole.
6. Install inside (BAT) terminal nut/washer assembly (C) on terminal stud and tighten finger-tight.
7. Position capacitor over holes in rectifier bridge and install rectifier bridge attaching screw (E) through capacitor connector and grounded heat sink into slip ring end housing. Tighten screw finger-tight.
8. Install insulated capacitor attaching screw (F) through capacitor connector and insulated heat sink into slip ring end housing. Tighten screw finger-tight.



RG6985 –UN–30NOV93

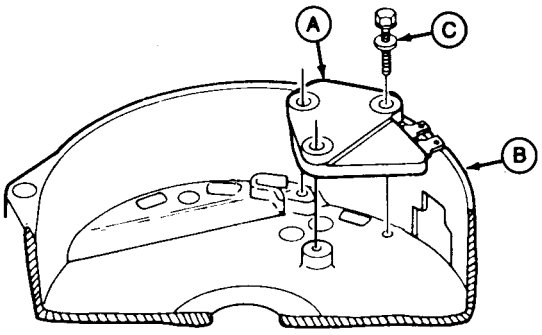
Slip Ring End Housing

A—Output (BAT) Terminal
B—Slip Ring End Housing
C—Inside (BAT) Terminal Nut/Washer Assembly
D—Capacitor
E—Rectifier Bridge Attaching Screw (Ground)
F—Capacitor Attaching Screw (Insulated)

RG,RG34710,2058 –19–06MAY02–4/10

IMPORTANT: Do not immerse or wipe regulator with solvent. Internal damage to regulator could result.

9. Before installing voltage regulator, be sure regulator and regulator mounting bosses in slip ring end housing are free of all dirt and grease. Wipe all contact areas with a clean, dry cloth.
10. Install regulator (A) to slip ring end housing (B) with regulator attaching screw (C) (ground). Tighten screw finger-tight.



RG6986 –UN–30NOV93

Install Regulator

A—Voltage Regulator
B—Slip Ring End Housing
C—Voltage Regulator Attaching Screw

Continued on next page

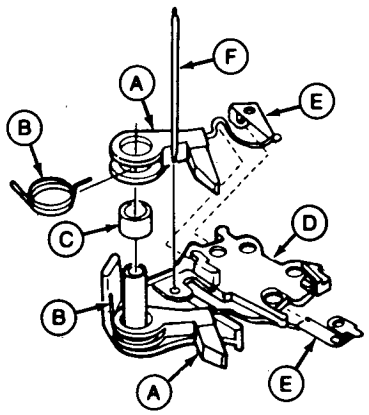
RG,RG34710,2058 –19–06MAY02–5/10

11. Install brushes (A), springs (B) and spacer (C) on brush holder (D).

NOTE: Brushes are identical, but brush leads and contact clips (E) are positioned differently.

12. Pin brushes in retracted position with brush pin (F).

A—Brush (with Arm)
B—Brush Spring
C—Spacer
D—Brush Holder
E—Brush Contact Clip
F—Brush Pin



RG6987 –UN–30NOV93

Install Brushes, Springs and Spacer

RG,RG34710,2058 –19–06MAY02–6/10

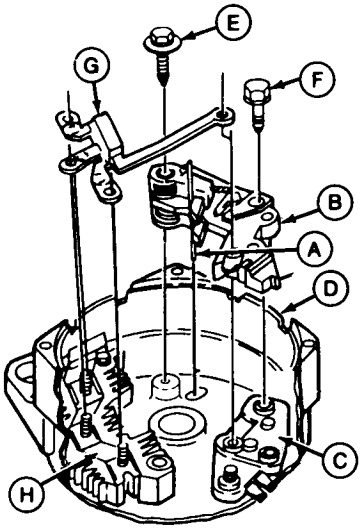
13. With brushes pinned in retracted position, position brush holder assembly (B) over holes in regulator (C) and slip ring end housing (D). Install brush holder attaching (pivot) screw (E) and one insulated regulator attaching screw (F). Tighten both screws finger-tight.

NOTE: Brush pin (A) must remain in place until final assembly.

Ensure that contact surfaces of brushes are free of grease and dirt.

14. Install diode trio (G) onto three threaded studs on rectifier bridge assembly (H). Position long connector strap on diode trio over mounting hole in brush holder and regulator.

A—Brush Pin
B—Brush Holder Assembly
C—Regulator
D—Slip Ring End Housing
E—Brush Holder Attaching (Pivot) Screw
F—Regulator Attaching Screw (Insulated)
G—Diode Trio
H—Rectifier Bridge



RG6988 –UN–30NOV93

Position Brush Holder Assembly

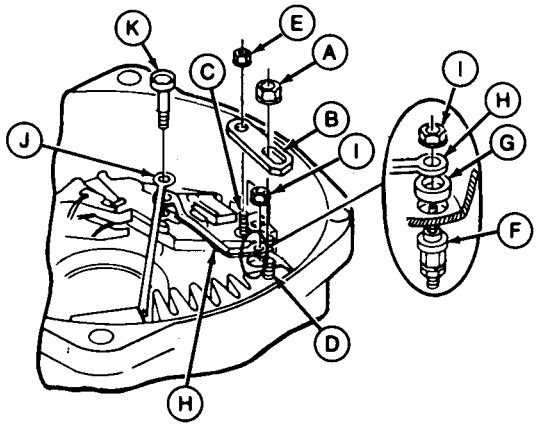
Continued on next page

RG,RG34710,2058 –19–06MAY02–7/10

15. Hold outside BAT terminal and temporarily remove the inside BAT terminal nut/washer assembly (A). Install regulator stud connector (B) to threaded regulator stud (C) and to inside BAT terminal stud (D). Reinstall inside BAT terminal nut/washer assembly (A) and install regulator nut/washer assembly (E) to regulator stud. Tighten two nuts finger-tight.

16. Install “I” terminal with outside insulator (F) (if used) to slip ring end housing and hold in place. Install inside insulator (G) and “I” terminal connector (H) over “I” terminal stud inside housing. Position other end of “I” terminal connector over mounting hole in brush holder. Install “I” terminal nut/washer assembly (I) onto “I” terminal stud. Tighten nut finger-tight.

17. Install insulated regulator attaching screw (K) to mounting hole in brush holder, passing through diode trio connector (J) and “I” terminal connector (if used). Tighten screw finger-tight.



RG6989 –UN–30NOV93

BAT Terminal

A—Inside BAT Terminal Nut/Washer Assembly
B—Regulator Stud Connector
C—Regulator Stud
D—BAT Terminal Stud
E—Regulator Stud Nut/Washer Assembly
F—“I” Terminal with Outside Insulator
G—Inside Insulator
H—“I” Terminal Connector
I—Inside “I” Terminal Nut/Washer Assembly
J—Diode Trio Connector
K—Regulator Attaching Screw (Insulated)

10
15
17

Continued on next page

RG,RG34710,2058 –19–06MAY02–8/10

10
15
18

18. Tighten the slip ring end housing components in the following order to specifications listed below:

    a. Inside output terminal nut (A).

    b. Rectifier bridge attaching screws (B).

    c. Insulated capacitor attaching screw (C).

    d. “R” terminal nut (D). It may be necessary to hold terminal on outside while tightening.

    e. Regulator mounting screw (E).

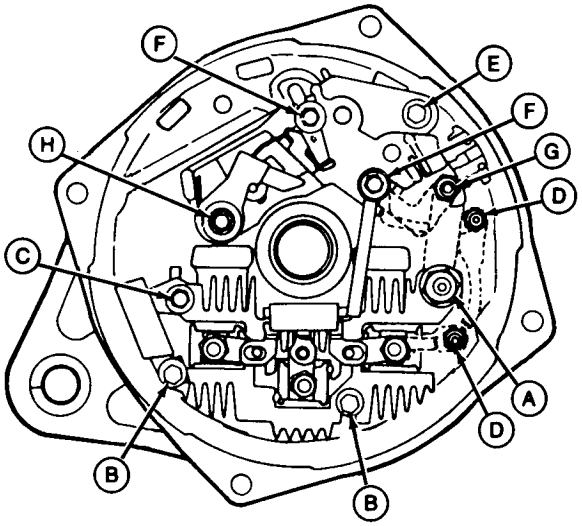
    f. Insulated regulator attaching screw.

    g. Regulator nut (G) (if used).

    h. Brush holder attaching (pivot) screw (H).

Slip Ring End Housing Components—Specification

Inside Output Terminal Nut (A)—Torque	5.5 N•m (50 lb-in.)
Rectifier Bridge Attaching Screws (B)—Torque	3.0 N•m (25 lb-in.)
Capacitor Attaching Screw (C)—Torque	2.5 N•m (22 lb-in.)
“R” Terminal Nut (D)—Torque	2.5 N•m (22 lb-in.)
Regulator Mounting Screws (E)—Torque	2 N•m (20 lb-in.)
Regulator Mounting Nut (G)—Torque	2.5 N•m (22 lb-in.)
Brush Holder Pivot Attaching Screw (H)—Torque	2 N•m (20 lb-in.)



RG6990 –UN–30NOV93

Slip Ring End Housing Components

A—Inside Output Terminal Nut
B—Rectifier Bridge Attaching Screws
C—Insulated Capacitor Attaching Screw
D—“R” Terminal Nut
E—Regulator Mounting Screw
F—Insulated Regulator Nut (If Used)
G—Regulator Nut
H—Brush Holder Attaching (Pivot) Screw

Continued on next page

RG,RG34710,2058 –19–06MAY02–9/10

19. If used, install debris shield mounting stud in slip ring end housing with inside washer to “I” terminal hole in housing. Install outside washer, lock washer and mounting stud on outside of housing. Tighten nut to specifications.

Specification

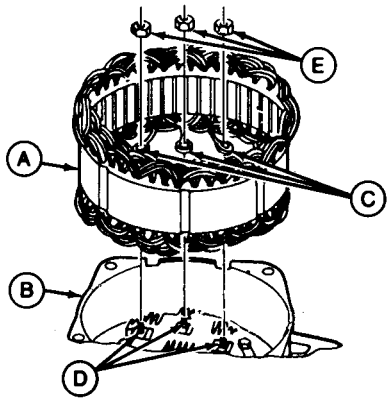
Stator Debris Shield Mounting
Stud Nut—Torque ..... 5.5 N•m (50 lb-in.)

20. Install stator (A) in slip ring end housing (B), placing three phase leads (C) over threaded studs (D) on rectifier bridge. Be sure stator is seated in register around edge of slip ring end housing.

21. Install rectifier bridge nuts on threaded studs. Tighten nuts to specifications.

Specification

Rectifier Bridge Nuts—Torque ..... 2.5 N•m (22 lb-in.)



RG6991 –UN–30NOV93

Install Components on Housing

A—Stator
B—Slip Ring End Housing
C—Phase Leads
D—Threaded Studs on Rectifier Bridge
E—Rectifier Bridge Nuts

10
15
19

RG,RG34710,2058 –19–06MAY02–10/10

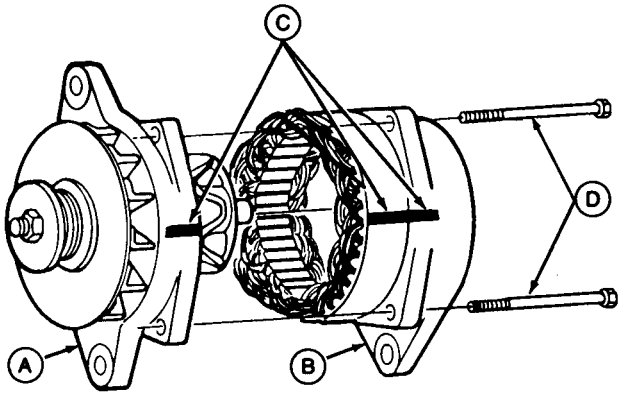
Final Assembly

1. Assemble drive end frame assembly (A) and slip ring end housing assembly (B) using alignment marks (C) to ensure proper alignment to parts. Install four through bolts (D) and tighten bolts to specifications.

Specification

Drive End-to-Slip Ring End
Housing Through Bolts—Torque..... 5.5 N•m (50 lb-in.)

A—Drive End Frame Assembly
B—Slip Ring End Housing Assembly
C—Alignment Marks
D—Through Bolts



RG6992 –UN–30NOV93

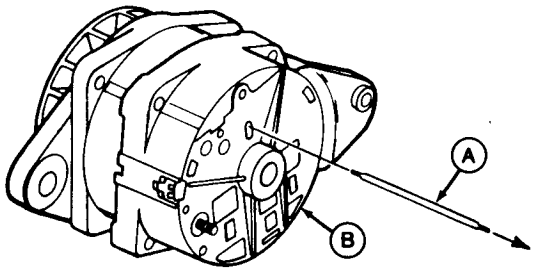
Final Assembly

Continued on next page

RG,RG34710,2059 –19–15MAR97–1/2

2. Remove brush pin (A) from slip ring end housing (B) to release brushes onto slip rings inside unit.

A—Brush Pin
B—Slip Ring End Housing



RG6993 –UN–30NOV93

Remove Brush Pin

RG,RG34710,2059 –19–15MAR97–2/2

Section 15
Motorola Alternators

Contents

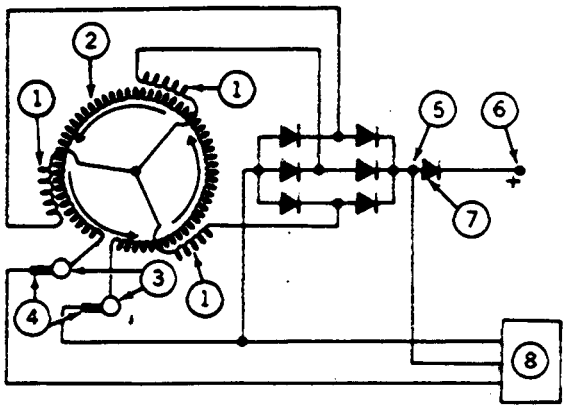
Motorola Alternator Operation

In an alternator, the magnetic field of the rotor is moved across stationary conductors in the stator. This permits permanent connection between the stator windings and the output terminal. Slip rings are used to transmit the field current to the rotor field winding.

The alternator produces power in the form of three-phase alternating current and voltage. The alternating current is rectified to direct current by a three-phase full-wave rectifier circuit using six silicon rectifier diodes. Since the diode will pass current in only one direction (from alternator to battery or load), the alternator does not require the use of cutout relay.

The entire DC output of the system passes through the isolation diode. This provides the system with several distinct advantages. It prevents the battery from discharging through the regulator and alternator field without the use of relays or switches. Electrically, the indicator lamp is connected across the isolation diode. When the system is operating properly, the alternator output voltage is very nearly the same as the battery voltage. This means that the voltage potential across the isolation diode is low and the indicator lamp shows that the alternator is charging.

The alternator output current is controlled by the current flow through the field coil (rotor). The amount of current required is determined and controlled by the regulator. Since there is very little residual magnetism in the alternator, it is necessary to supply a small amount of excitation current to the field (rotor) to start the process of current generation. The excitation resistor supplies this starting current when the key switch is turned on. This resistor is enclosed in the sealed regulator case. Once the alternator is excited, a voltage is developed at the regulator terminal and the voltage regulator takes over control of the system voltage.



T52184 –UN–31MAY89

15
05
1

Motorola Alternator Operation

1—Stator
2—Rotor Winding (Field)
3—Rotor Slip Ring
4—Brushes
5—Regulator Terminal
6—Output Terminal
7—Isolation Diode
8—Regulator

RG,RG34710,2060 –19–15MAR97–1/1

Motorola Regulator Operation

The transistor regulator is an electronic switching device composed principally of transistors, resistors, and diodes to form a completely static unit containing no moving parts.

The transistors are used to switch the alternator field current on and off, and are controlled by the resistors and the Zener diode.

15
05
2

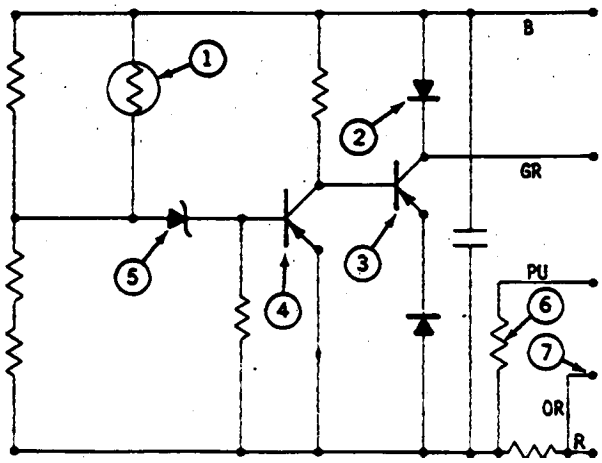
A Zener diode is a special diode that will break down and permit a reverse flow of current when the voltage reaches a certain value, without damaging the semiconductor material. This diode is the trigger which senses the maximum desired voltage and turns the transistor on or off to limit charging system voltage.

The field discharge diode provides an alternator current path to protect the transistors from induced high voltage from the alternator field windings. The sudden stopping of field current by the transistor and subsequent collapsing of the magnetic field causes an induced voltage in the rotor windings.

The thermistor (RT) is a temperature compensating resistor. Its resistance varies with temperature and controls the operating point of the Zener diode so that a high system voltage is produced in cold weather, when needed, and a lower system voltage in warm weather.

When the voltage appearing at the output terminal of the alternator rises to a predetermined value (14.4 volts), the voltage which appears across the Zener diode conducts. This conduction of the Zener diode permits current to flow in the base of transistor T-1. This causes transistor T-1 to turn on and reverse bias transistor T-2, thus turning off the current applied to the alternator field.

When the system voltage drops below the predetermined value, the Zener diode stops conducting, T-1 turns off and T-2 turns on. When transistor T-2 is switched on, field current again is supplied to the alternator.



Motorola Regulator Operation

1—Thermistor (RT)
2—Field Discharge Diode
3—Transistor (T-2)
4—Transistor (T-1)
5—Zener Diode
6—Excitation Resistor
7—To Alternator Indicator Light

Continued on next page

RG,RG34710,2061 –19–06MAY02–1/5

The operation of transistor T-2 is in effect like a switch, turning the alternator field current on and off as the electrical supply varies due to the varying electrical load. This action occurs many times a second, so fast it cannot be detected in the alternator output.

The solid-state regulator is either mounted on rear of alternator or mounted internally. It controls output by controlling current through field. In operation, regulator has the following three phases.

Continued on next page

RG,RG34710,2061 –19–06MAY02–2/5

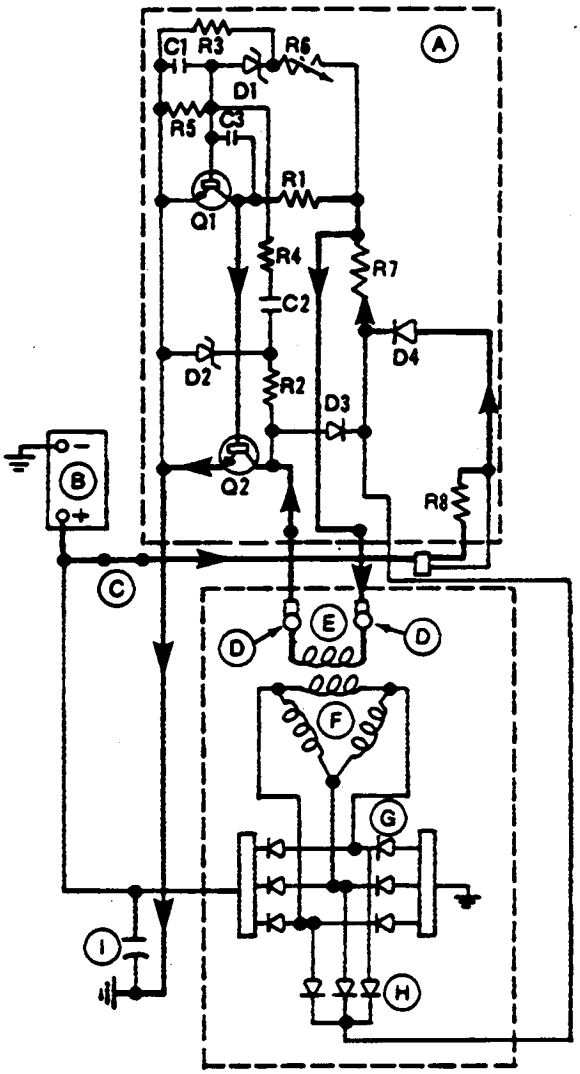
15
05
3

Phase 1—Alternator Stopped

(Phase 1 also applies when alternator is turning but only if not running fast enough for output to exceed battery voltage.)

1. Current flows from battery (B) through key switch (C) to regulator (A).
2. From there, current flows through resistors R8, R7, and R1 to transistor Q2, turning it on.
3. Transistor Q2 then provides a path so current can flow through field (E) to ground, enabling alternator to generate electricity.
4. Zener diode D1 prevents flow of current to transistor Q1. A Zener diode is a special type of diode which will not permit current to pass until voltage reaches a certain preset level. If voltage exceeds that level, current can pass through the Zener diode.

A—Regulator
B—Battery
C—Key Switch
D—Rotor
E—Field Windings
F—Delta Stator
G—Rectifier Diodes
H—Diode Trio
I—Suppression Capacitor



N37761 –UN–02MAY89

Phase 1—Alternator Stopped

Continued on next page

RG,RG34710,2061 –19–06MAY02–3/5

Phase II—Generating Electricity

1. The key switch (C) and rectifier bridge diodes (G) all have equal voltage. Therefore, no current flows from key switch to regulator.

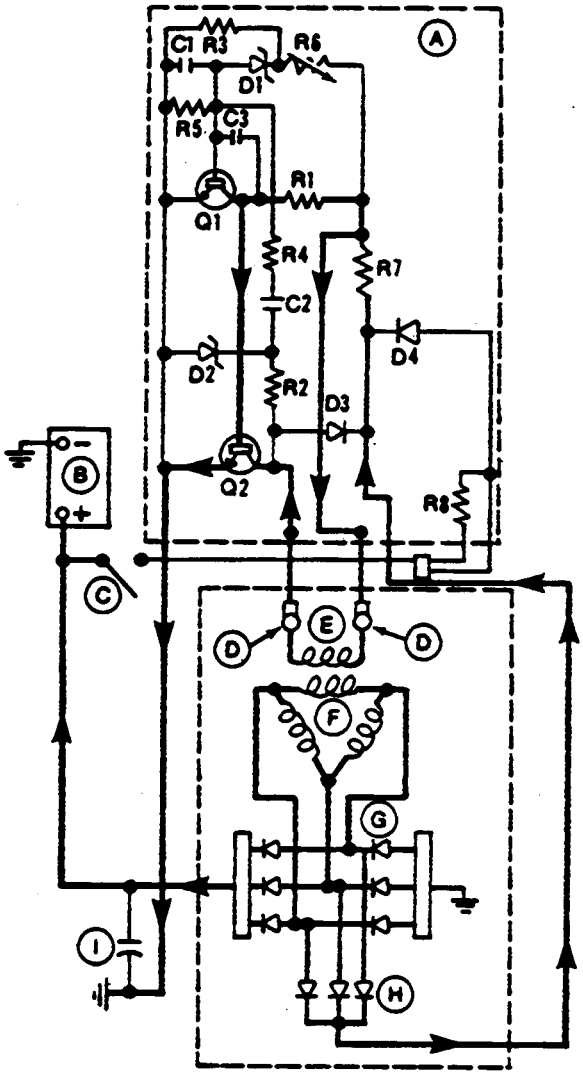
2. Current, now coming from rectifier bridge diodes, flows through resistors R7 and R1 to turn on transistor Q2.

3. Transistor Q2 still provides path to ground through field (E), enabling alternator to generate electricity.

4. Since the field is rotating, it does generate electricity. Alternating current is included in the stator windings (F). The rectifier bridge converts it to direct current, providing current to run electrical accessories and charge the battery.

5. Output voltage still has not reached critical voltage of the Zener diode D1.

A—Regulator
B—Battery
C—Key Switch
D—Rotor
E—Field Windings
F—Delta Stator
G—Rectifier Diodes
H—Diode Trio
I—Suppression Capacitor



Phase II—Generating Electricity

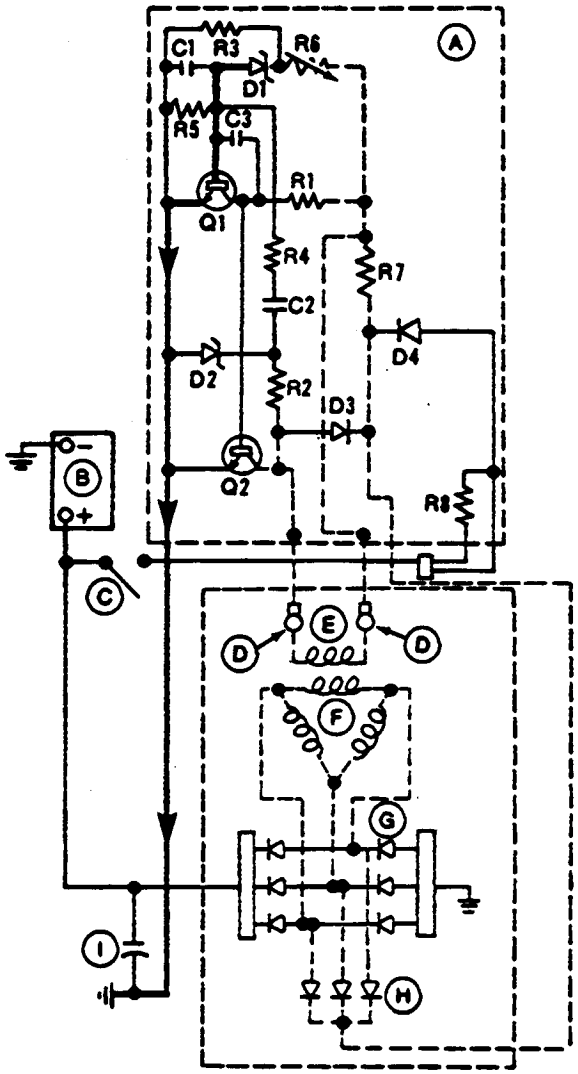
Continued on next page

RG,RG34710,2061 –19–06MAY02–4/5

Phase III—Shut-Off

1. Output voltage reaches critical voltage of Zener diode D1.
2. Current can now pass through Zener diode D1 to turn on control transistor Q1
3. Current from transistor Q1 cuts off voltage to transistor Q2, turning it off. There is now no path to ground for current through field (E).
4. Current through field is shut off instantly, and alternator stops generating electricity.
5. With transistor Q2 off, system voltage starts to drop in unrestricted fashion until it falls below the Zener diode D1 critical voltage. When this occurs, Zener diode D1 and transistor Q1 switch off and Q2 turns on again.
6. Phase II and III are repeated many times per second to maintain voltage at proper level.

A—Regulator
B—Battery
C—Key Switch
D—Rotor
E—Field Windings
F—Delta Stator
G—Rectifier Diodes
H—Diode Trio
I—Suppression Capacitor



N37763 –UN–02MAY89

Phase III—Shut-Off

RG,RG34710,2061 –19–06MAY02–5/5

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B5A –19–25APR02–1/3

15
10
1

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUO1004,0000B5A –19–25APR02–2/3

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000B5A –19–25APR02–3/3

Motorola 8E-Series Charging Circuit Repair Specifications

Item	Measurement	Specification
Brush (24-Volt, 42-Amp)	Minimum Exposed Length	6.4 mm (0.25 in.)
Brush (12-Volt, 65-Amp)	Minimum Exposed Length	4.8 mm (0.189 in.)
Motorola 8E-Series Alternator		
Pulley-to-Shaft Nut	Torque	60 N•m (45 lb-ft)
Rear Housing-to-Front Housing Cap Screws	Torque	7.0—8.3 N•m (50—60 lb-in.)
Bearing Retainer Cap Screws	Torque	3.5—4.8 N•m (25—35 lb-in.)
Output Terminal Nut	Torque	7 N•m (50 lb-in.)
Indicator Light Terminal	Torque	2.3 N•m (20 lb-in.)
Slip Ring-to-Shaft	Torque	40 N•m (30 lb-ft)

OUO1004,0000B59 –19–21SEP00–1/1

Motorola 8E-Series Charging Circuit Test Specifications

John Deere Part No.	Motorola Part No.	Volts	Rated Amps	Output Test Amps (Hot)[a]	Field Current[b] Amps	Winding Resistance[c] Ohms
AT103344	8EM2009NB	12	65	54—62	3.2—3.7	4.0—4.7
AT115049	8EM3002GB	24	42	37—42	1.8—2.3	12.0—13.0
AT125414	8EM2009ND	12	65	54—62	3.2—3.7	4.0—4.7
AT125430	8EM3002GC	24	42	37—42	1.8—2.3	12.0—13.0
RE28186	8EM3002GA	24	42	37—42	1.8—2.3	12.0—13.0

[a]Output test @ 3000—4000 RPM.

[b]Field current @ 20—27°C (70—80°F); @ 10V for 12V systems and 20V for 24V systems.

[c]Winding resistance @ 20—27°C (70—80°F).

RG,RG34710,2066 –19–08SEP00–1/1

General Information

The Motorola 8E-Series charging systems are available in two basic versions on John Deere Engines. One version (12-volt, 65-amp) includes an integral, solid-state voltage regulator. The other version (24-volt, 42-amp) is equipped with a blade terminal for connection to a remote, externally-mounted voltage regulator.

Refer to the proper repair procedure for the charging system used on your John Deere Engine.

RG,RG34710,2067 –19–15MAR97–1/1

Remove Alternator for Repair

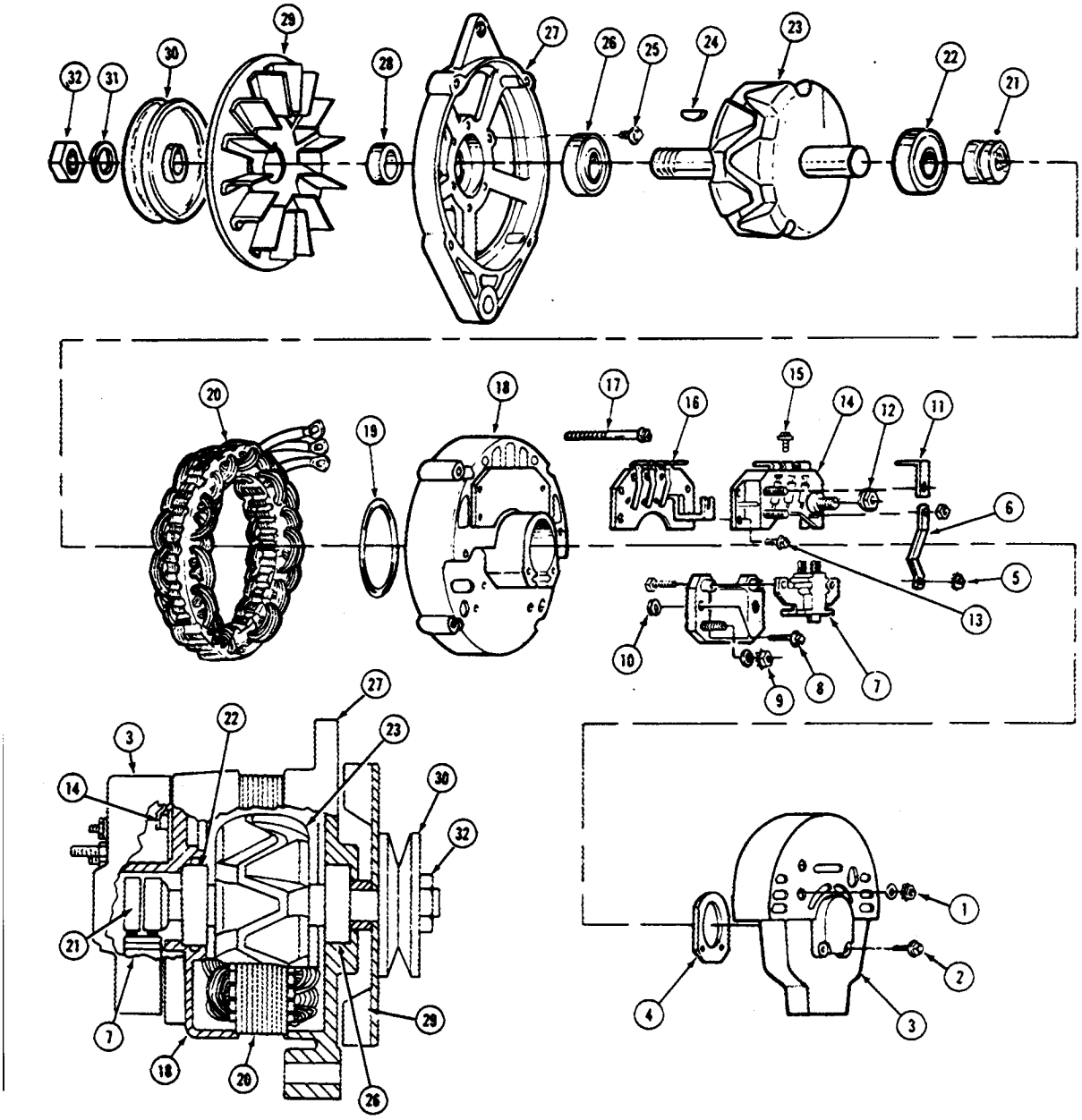
Refer to your machine technical manual for removal of alternator.

IMPORTANT: Never immerse alternator in cleaning solvent. Remove dirt and grease by scraping and using a stiff brush with solvent. Dry with compressed air.

ONLY rosin core solder should be used for soldering operations. The use of acid core solder will result in rapid corrosion of the windings and eventual failure of the complete alternator unit.

RG,RG34710,2068 –19–15MAR97–1/1

Disassemble and Test Motorola 8E-Series (12-Volt, 65 Amp) Alternator



Motorola 8E-Series Alternator

1—Nut (2 Used)
2—Screw (2 Used)
3—Rear Cover
4—Felt Gasket
5—Nut
6—D + Strap
7—Brush Assembly
8—Screw (2 Used)
9—Voltage Regulator
10—Insulating Washer (2 Used)
11—AC Tap Strap
12—B + Nut
13—Screw (4 Used)
14—Diode Field
15—Screw (3 Used)
16—Rectifier Diode Bridge
17—Through Bolt (4 Used)
18—Rear Housing
19—O-Ring
20—Stator Assembly
21—Slip Ring
22—Rear Bearing
23—Rotor Assembly
24—Woodruff Key
25—Bearing Retainer Screw (3 Used)
26—Front Bearing
27—Front Housing
28—Fan Spacer
29—Fan
30—Pulley
31—Lock Washer
32—Nut

Continued on next page

RG,RG34710,2069 –19–15MAR97–1/7

1. Inspect and test brush assembly. Brush set may be reused if brush length is within specification.

Specification

Brush (24-Volt, 42-Amp)—
Minimum Exposed Length ..... 6.4 mm (0.25 in.)

Brush (12-Volt, 65-Amp)—
Minimum Exposed Length ..... 4.8 mm (0.189 in.)

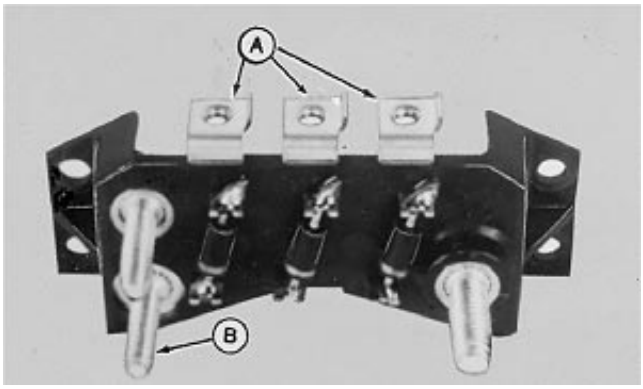
Brushes must not be oil soaked, cracked or grooved on the sides. Replace defective brush assembly.

RG,RG34710,2069 –19–15MAR97–2/7

2. Inspect and test diode trio. Test diode for continuity from each of three terminals (A) to D+ stud (B). Continuity must be observed in one direction only.

   Replace entire diode trio if any one diode fails test.

A—Diode Terminals
B—D+ Stud



T6478AD –UN–02NOV88

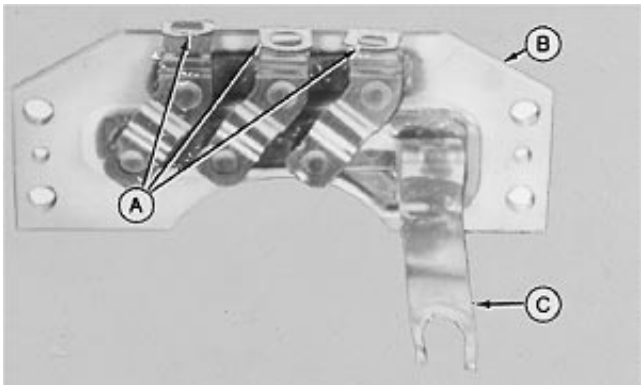
Diode Trio

RG,RG34710,2069 –19–15MAR97–3/7

3. Inspect and test rectifier bridge. Test for continuity between plate (B) and each of three diode terminals (A). Then test for continuity between terminal (C) and each of the three diode terminals. Continuity should be observed in one direction only, and all diodes should check alike.

   Replace entire rectifier bridge if any diode fails test.

A—Terminals
B—Plate
C—Terminal



T6478AE –UN–02NOV88

Test Continuity

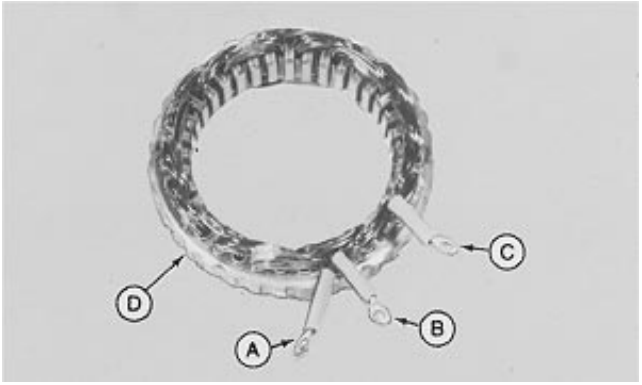
Continued on next page

RG,RG34710,2069 –19–15MAR97–4/7

4. Inspect and test stator. Test for continuity between terminals (A, B and C). There should be no continuity from any terminals (A, B, or C) and laminations (D).

   Replace stator if windings show any signs of discoloration.

   A—Terminal
   B—Terminal
   C—Terminal
   D—Laminations



T6478AF –UN–02NOV88

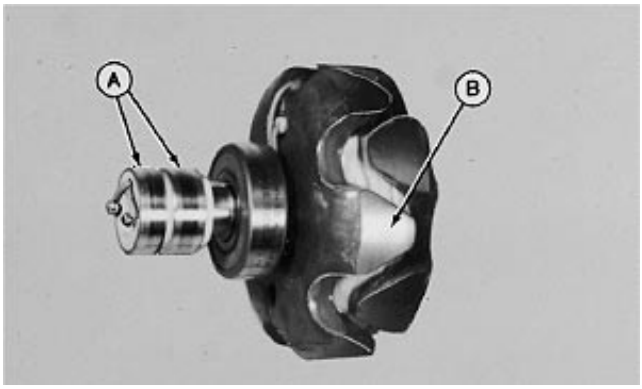
Inspect and Test Stator

RG,RG34710,2069 –19–15MAR97–5/7

5. Inspect and test rotor assembly. Test resistance between each slip ring (A). Then test for no continuity between each slip ring and pole finger (B).

   Slip ring resistance should be 4.0—4.7 ohms @ 20—27°C (70—80°F) for 12-volt systems and 12.0—13.0 ohm for 24-volt system.

   A—Slip Ring
   B—Pole Finger



T6478AA –UN–02NOV88

Inspect and Test Rotor Assembly

Continued on next page

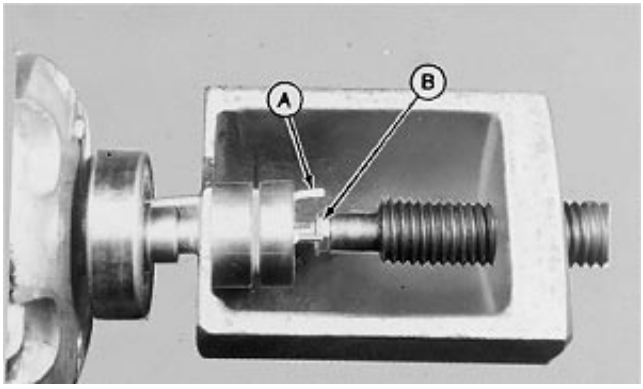
RG,RG34710,2069 –19–15MAR97–6/7

6. If necessary to replace slip rings, unsolder rotor leads (A) from slip ring terminals. Straighten rotor leads (A) and insert a No. 10 x 1 in. cap screw (B) into center of slip ring assembly. Remove slip ring assembly using a bearing puller.

7. If necessary, remove rear bearing using a bearing puller.

NOTE: Replace bearing if removed.

A—Rotor Leads
B—No. 10 x 1 in. Cap Screw



T6486AH –UN–02NOV88

Unsolder Rotor Leads

15
10
7

RG,RG34710,2069 –19–15MAR97–7/7

Assemble Motorola 8E-Series (12-Volt, 65 Amp) Alternator

For alternator assembly, the following is a list of special reassembly requirements:

Replace bearings if removed.

Guide rotor leads through one of the oval passages in the slip ring assembly. The oval passages must line up with the groove in the rotor shaft. Solder rotor leads to terminals on slip ring.

15
10
8

Tighten front bearing retainer screws (B) to specifications.

Press front housing down until inner bearing (D) race contacts shoulder on the shaft.

Apply a thin film of heat sink compound to back of diode rectifier bridge (A) and mating surface of rear housing.

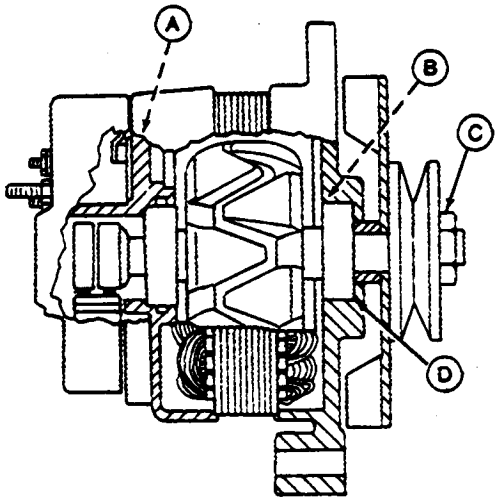
Check to be sure felt gasket is installed.

Tighten shaft nut (C) to specifications.

Tighten through bolts (4 used) to specifications.

Motorola 8E-Series—Specification

Pulley-to-Shaft Nut—Torque	60 N•m (45 lb-ft)
Rear Housing-to-Front Housing Cap Screws—Torque	7.0—8.3 N•m (50—60 lb-in.)
Bearing Retainer Cap Screws—Torque	3.5—4.8 N•m (25—35 lb-in.)
Output Terminal Nut—Torque	7 N•m (50 lb-in.)
Indicator Light Terminal—Torque	2.3 N•m (20 lb-in.)
Slip Ring-to-Shaft—Torque	40 N•m (30 lb-ft)



T6493BC –UN–09DEC88

Assemble Motorola 8E-Series Alternator

A—Diode Rectifier Bridge
B—Front Bearing Retainer
C—Shaft Nut
D—Inner Bearing

RG,RG34710,2070 –19–15MAR97–1/1

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B5C –19–25APR02–1/3

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUO1004,0000B5C –19–25APR02–2/3

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000B5C –19–25APR02–3/3

Service Equipment and Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC). Some tools may be available from a local supplier.

15
15
2

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000BBE –19–18OCT00–1/2

Battery Load Tester JT28001

Test rotor windings.

OUO1004,0000BBE –19–18OCT00–2/2

Motorola HC-, MA-, MR-Series Charging Circuit Repair Specifications

Item	Measurement	Specification
Brush	Minimum Exposed Length	6.4 mm (0.25 in.)
Slip Ring Retainer Cap Screw	Torque	5.1 N•m (45 lb-in.)
Fan Pulley-to-Shaft Nut	Torque	47—68 N•m (35—50 lb-ft)
Stator Stud Lock Nuts	Torque	3.5—4.5 N•m (33—40 lb-in.)
Housing Through Bolts	Torque	5.5—7.0 N•m (50—60 lb-in.)
Brush Assembly Mounting Screws	Torque	2.5—3.5 N•m (20—30 lb-in.)
Regulator Mounting Cap Screws	Torque	4.5—5.0 N•m (40—45 lb-in.)
Isolation Diode Nuts	Torque	2.5—3.5 N•m (20—30 lb-in.)
Alternator Terminal Nuts	Torque	2.5—3.5 N•m (20—30 lb-in.)

OUO1004,0000BB2 –19–28SEP00–1/1

Motorola HC-, MA-, MR-Series Charging Circuit Test Specifications

John Deere Part No.	Motorola Part No.	Volts	Rated Amps	Output Test[a] Amps (Hot)	Field Current[b] Amps	Winding Resistance[c] Ohms
AH112211	8MR2030T	12	90	79—82	4.10—4.40	2.3—2.4
AR40420	70D44110C01	12	55	—	—	—
AR43989	8MA2003PA	12	72	—	1.8—2.0	5.0—5.4
AR50909	8MR2012P	12	72	—	1.8—2.0	5.0—5.4
AR52077	8MR2012PS,MA12JD602	12	70	—	1.8—2.0	5.0—5.4
AR52078	8HC2003PS	12	72	—	1.8—2.0	5.0—5.4
AR53261	70D44086B05	12	35	—	—	—
AT21618	A12NJD454	12	35	—	1.95—2.55	4.2—5.5
AT28453	MA12NJD603	12	55	43—46	1.65—2.25	4.0—5.2
AT31668	70D44160B	12	22	—	—	—
AT31670	8MA2002KS	12	51	43—46	1.65—2.55	4.0—5.2
AT41951	70D44725C03	12	37	—	—	—
AT44644	8HC3010G	24	42	30	1.28—1.88	11.0—14.0
AT49446	8HC3010G	24	42	30	1.28—1.88	11.0—14.0
AT55539	8HC2015L, 8HC2012F	12	62	51—54	2.10—2.50	4.1—4.7
RE50811	8MR2069T	12	90	79—82	4.10—4.40	2.3—2.4

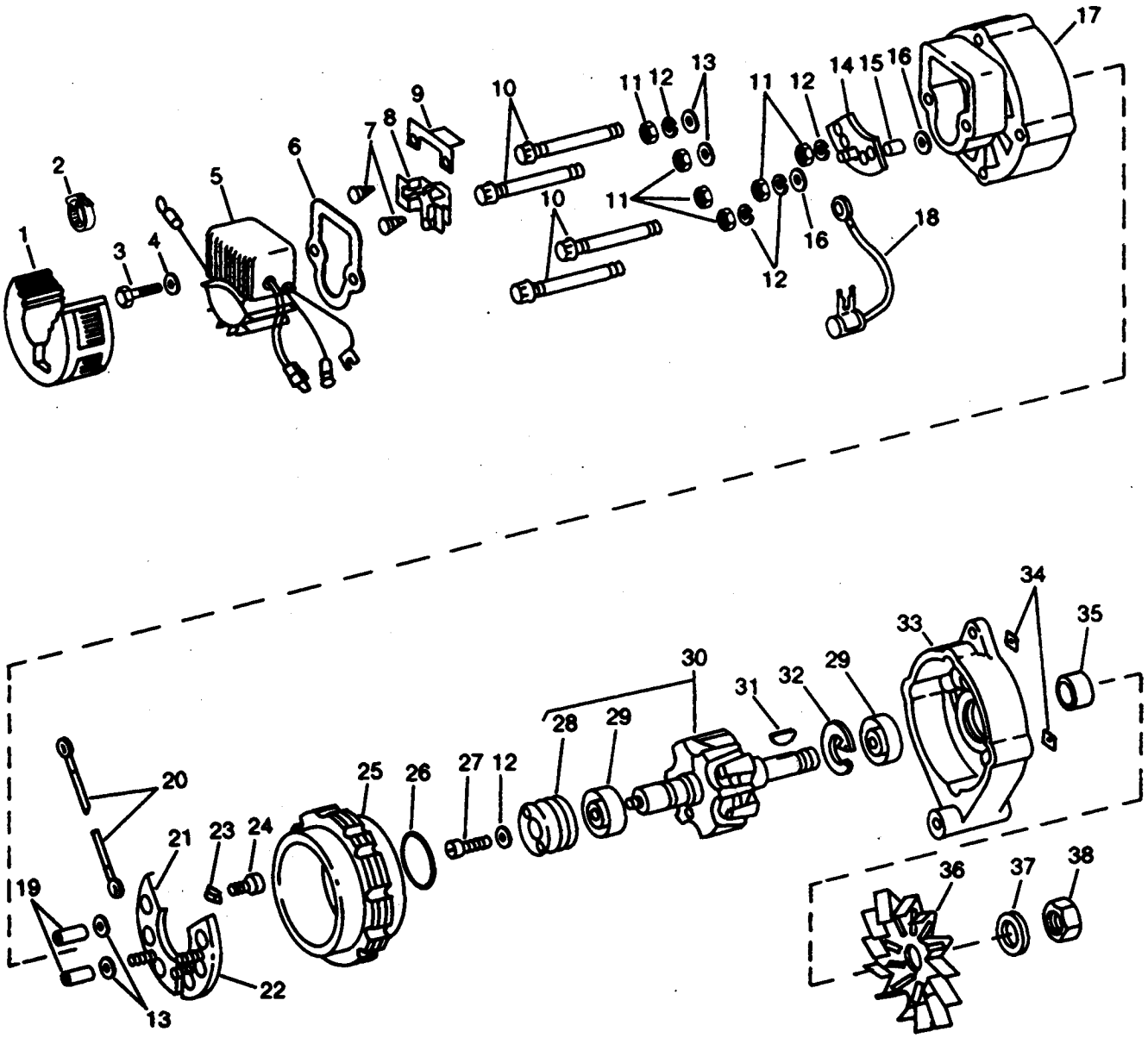
[a]Output test @ 3000—4000 RPM.

[b]Field current @ 20—27°C (70—80°F); @ 10V for 12V systems and 20V for 24V systems.

[c]Winding resistance @ 20—27°C (70—80°F).

RG,RG34710,2072 –19–08SEP00–1/1

Disassemble and Test Motorola HC-, MA-, MR-Series Alternator

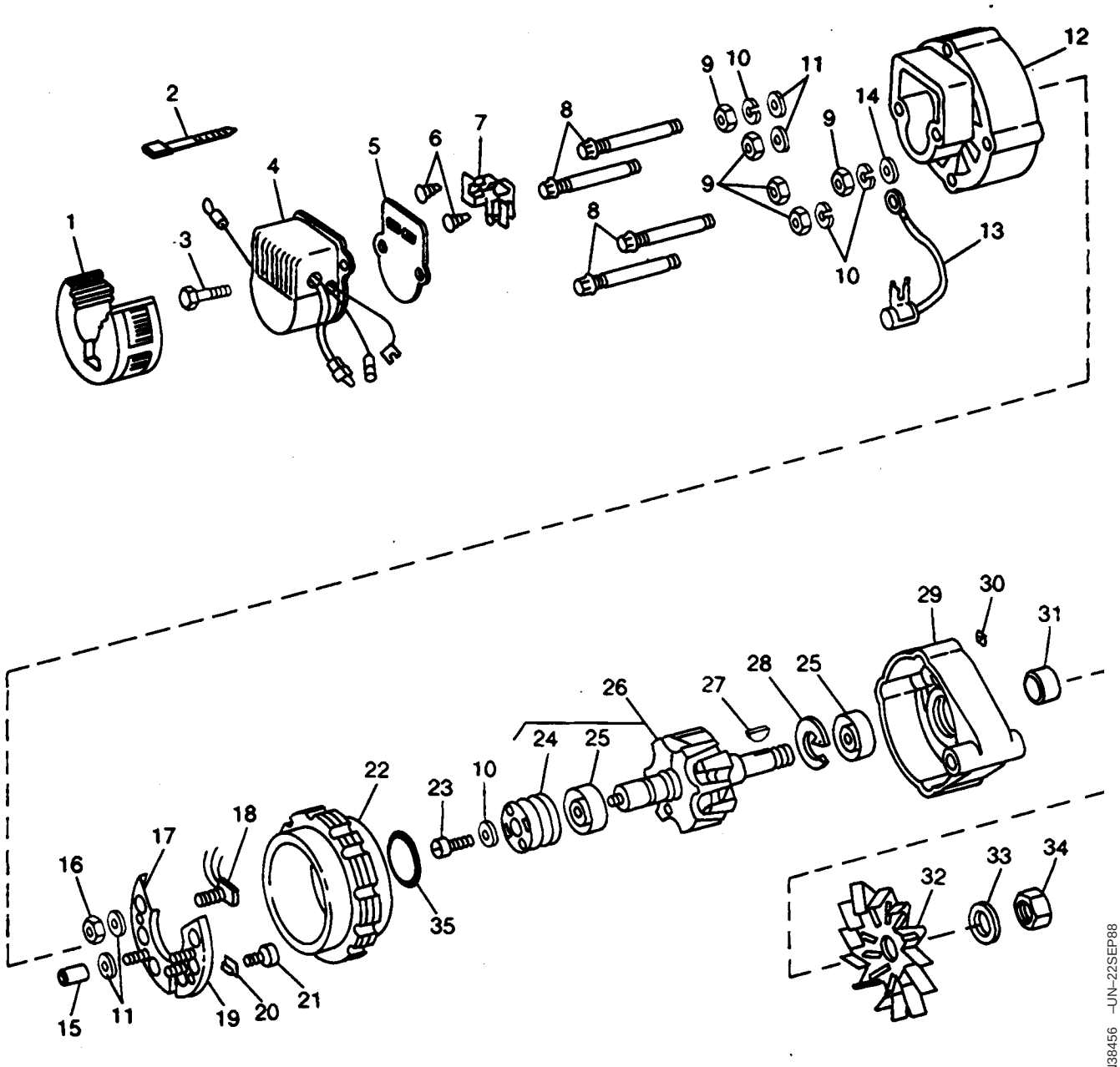


HC-, MA-, MR-Series with Isolation Diode

1—Cover
2—Tie Strap
3—Screw (2 Used)
4—Lock Washer
5—Regulator
6—Gasket
7—Screws (2 Used)
8—Brush Holder
9—Isolator
10—Through Bolts (4 Used)
11—Nut (6 Used)
12—Lock Washer (5 Used)
13—Washer (4 Used)
14—Diode, Isolation
15—Sleeve
16—Washer (2 Used)
17—Housing
18—Capacitor
19—Bushing (2 Used)
20—Wiring Lead
21—Positive Ring
22—Negative Ring
23—Insulator
24—Bolt
25—Stator
26—O-Ring
27—Screw
28—Ring
29—Bearing (2 Used)
30—Rotor
31—Key
32—Retainer
33—Housing
34—Nut (4 Used)
35—Spacer
36—Fan
37—Lock Washer
38—Nut

Continued on next page

RG,RG34710,2073 –19–06MAY02–1/30



HC-, MA-, MR-Series With Diode Trio

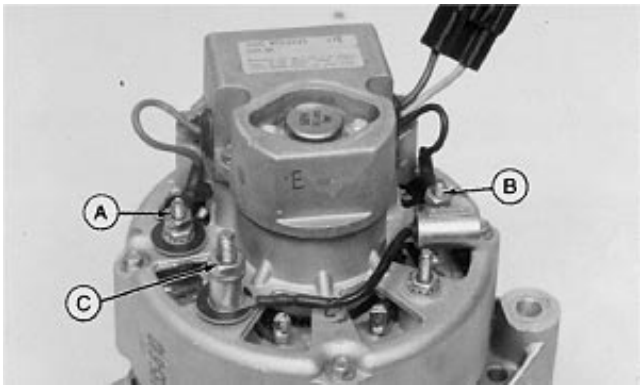
1—Screen
2—Tie Strap
3—Screw (4 Used)
4—Regulator
5—Gasket
6—Screws (2 Used)
7—Brush Holder
8—Through Bolts (4 Used)
9—Nuts (5 Used)
10—Lock Washer (6 Used)
11—Isolation Washer (7 Used)
12—Rear Housing
13—Capacitor
14—Washer
15—Spacer
16—Nuts (2 Used)
17—Diode Plate
18—Diode Trio
19—Rectifier Diode
20—Isolation Diode
21—Bolt
22—Stator
23—Screw
24—Slip Rings
25—Bearing (2 Used)
26—Rotor Assembly
27—Key
28—Retainer
29—Front Housing
30—Square Nuts
31—Spacer
32—Fan
33—Washer
34—Nut
35—O-Ring

Continued on next page

IMPORTANT: Voltage regulator wires must be disconnected before testing diodes to obtain accurate results.

1. Disconnect voltage regulator wires on regulator (A), negative output (B) and positive output (C) terminals.

A—Voltage Regulator
B—Negative Output Wire
C—Positive Output Wire



T6558AI –UN–02NOV88

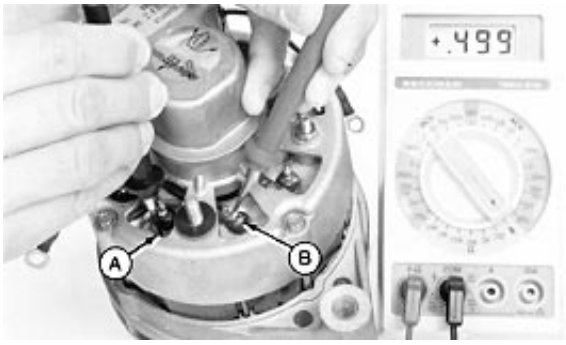
Output Terminals

RG,RG34710,2073 –19–06MAY02–3/30

IMPORTANT: The diode test position must be used on meters to get accurate results. Follow manufacturer's instructions for your meter to test diodes.

2. Test positive and negative diodes in both directions using an ohmmeter. Put one probe on a diode lead (B) and the other probe on diode plate (A) to get a reading.

   A diode with a high reading in one direction and a low reading in the other direction is good. A diode with the same reading in both directions is bad and should be replaced.



T84666 –UN–07NOV88

Test Diodes

A—Diode Plate
B—Diode Lead

Continued on next page

RG,RG34710,2073 –19–06MAY02–4/30

NOTE: Illustration shows alternator equipped with an isolation diode plate. Some applications do not use this plate.

3. Check isolation diode using volt-ohm-amp meter with selector indicator in diode test position.

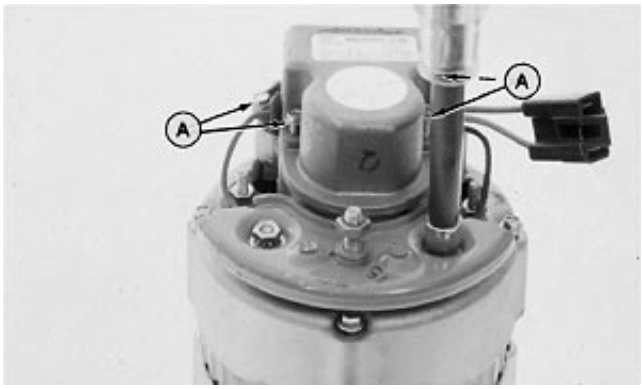
   The meter must register OL in one direction and approximately 0.50 volts in the other. If it does not, replace diode.

Alternator with Isolation Diode Plate

RG,RG34710,2073 –19–06MAY02–5/30

4. Loosen regulator cap screws (A). Remove two nuts to remove isolation diode plate, if equipped.

   A—Regulator Cap Screws (4 Used)



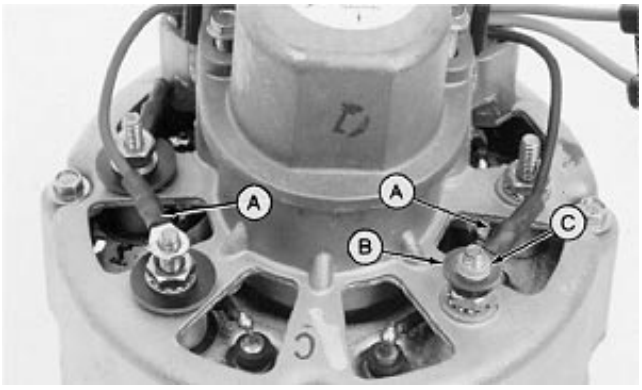
Regulator Cap Screws

Continued on next page

RG,RG34710,2073 –19–06MAY02–6/30

5. Remove sleeve (C), insulator washer (B) and regulator wires (A) from alternator terminals.

A—Regulator Wires
B—Insulator Washer
C—Sleeve



T6015AT –UN–06APR90

Remove Sleeve, Washer, and Wires

RG,RG34710,2073 –19–06MAY02–7/30

6. Test the three negative diodes with selector in diode test position.

   Touch one probe to a diode and the other probe to the ground terminal. Take reading. Reverse probes (A) and take another reading.

   The meter must register OL in one direction and approximately 0.50 volts in the other on all three diodes. If it does not, replace the negative diode plate.

A—Meter Probes

T6015AL –UN–06APR90

Test Negative Diodes

Continued on next page

RG,RG34710,2073 –19–06MAY02–8/30

7. Test the three positive diodes (A) with selector in diode test position.

   Touch one probe to a diode (A) and the other probe to diode plate post. Take reading. Reverse probes and take another reading.

   The meter must register OL in one direction and approximately 0.50 volts in the other on all three diodes. If it does not, replace the positive diode plate.

   A—Three Positive Diodes

Test Positive Diodes

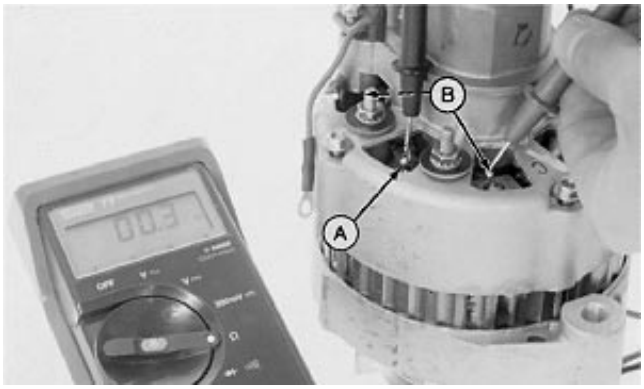
RG,RG34710,2073 –19–06MAY02–9/30

8. Check the stator windings for continuity.

   Touch one probe to a diode (A) and the other probe to each of the other two diodes (B) attached to the same diode plate. Repeat step for other diode plate.

   If there is no continuity in any of the connections, there is an open circuit in the stator windings and the stator must be replaced.

   A—Diode
   B—Two Diodes



Check Stator Windings

Continued on next page

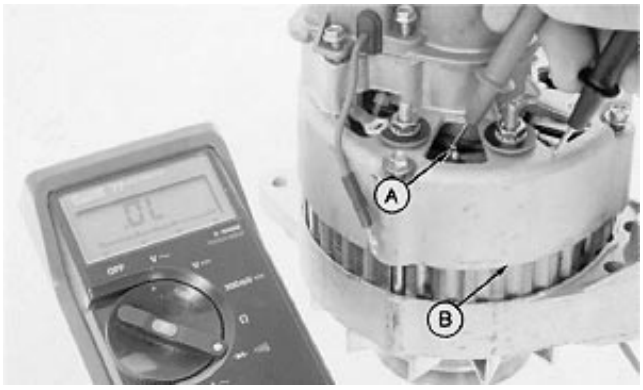
RG,RG34710,2073 –19–06MAY02–10/30

9. Check stator for a grounded winding.

   Touch one probe to a diode (A) and the other probe to the rear alternator housing (B). Take reading. Reverse probes and take another reading.

   The meter must register continuity in one direction only. If continuity is registered in both directions, a stator winding is grounded and the stator must be replaced.

A—Diode
B—Rear Alternator Housing



T6015BA –UN–06APR90

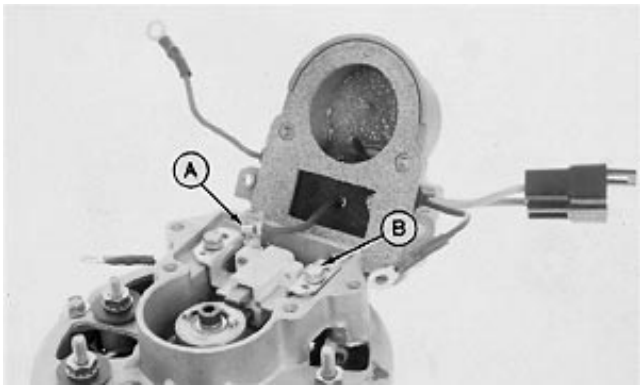
Check Stator for Grounded Winding

RG,RG34710,2073 –19–06MAY02–11/30

10. Remove screws and disconnect wire (A) to remove regulator.

11. Remove cap screws (B) to remove brushes.

A—Wire
B—Cap Screws (2 Used)



T6015AY –UN–06APR90

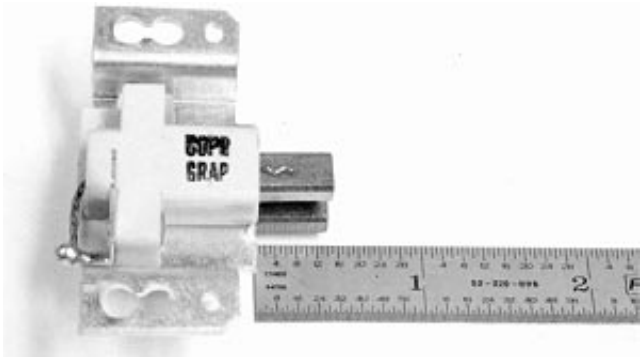
Remove Regulator and Brushes

RG,RG34710,2073 –19–06MAY02–12/30

12. Check the condition of the springs, connections, and for free movement of the brushes. If either brush is worn to less than specified length, or is cracked or oil soaked, replace the brush assembly.

Specification

Brush—Minimum Exposed Length..... 6.4 mm (0.25 in.)



T84656 –UN–07NOV88

Check Movement of Brushes

Continued on next page

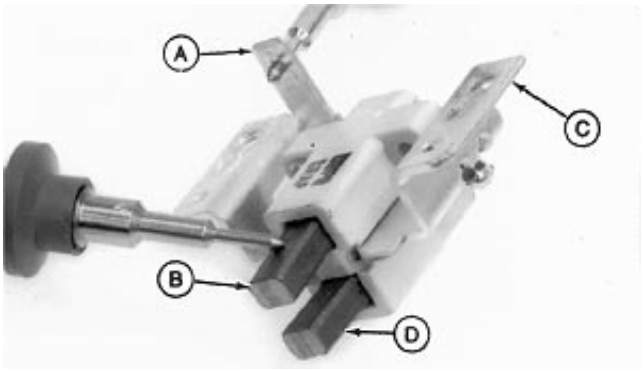
RG,RG34710,2073 –19–06MAY02–13/30

13. Check for continuity between terminal (A) and brush (B) and bracket (C) and brush (D). If there is no continuity at either brush, replace the brush assembly.

14. Check for continuity between terminal (A) and bracket (C). If there is continuity, replace the brush assembly.

15. Check for continuity between terminal (A) and brush (D). If there is continuity, replace the brush assembly.

A—Terminal
B—Brush
C—Bracket
D—Brush



T87568 –UN–23FEB90

Check for Continuity

15
15
11

RG,RG34710,2073 –19–06MAY02–14/30

16. Check rotor windings for continuity (a low resistance reading will be seen) using an ohmmeter.

    If there is no continuity (open circuit), check soldered connections (A). If connections are good, replace rotor.

NOTE: Place meter probes on edges of slip rings to prevent scratching brush contact area.

A—Soldered Connections

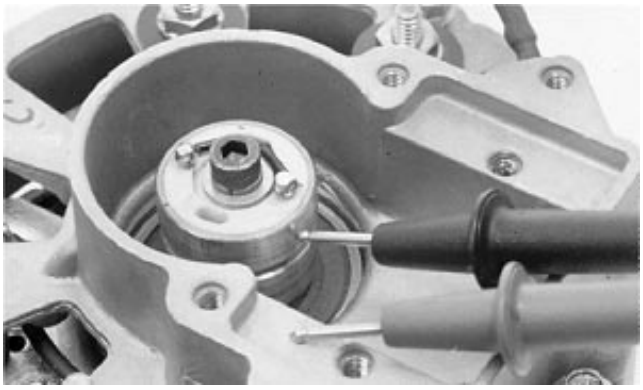
T84674 –UN–07NOV88

Check Soldered Connections

Continued on next page

RG,RG34710,2073 –19–06MAY02–15/30

17. Check for grounded rotor windings. If there is continuity (short circuit), replace rotor.



Check for Grounded Rotor Windings

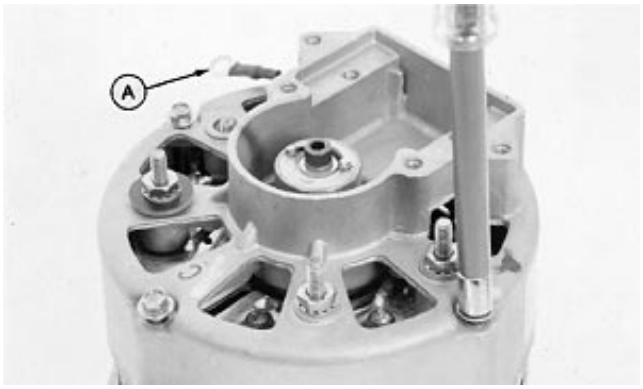
RG,RG34710,2073 –19–06MAY02–16/30

18. Remove nut and isolation washer. Disconnect wiring lead (A).

19. Remove four cap screws to remove rear housing cover.

NOTE: Some units use square nuts with the through bolts; others have threaded holes in the front housing.

A—Wiring Lead



Disconnect Wiring Lead

RG,RG34710,2073 –19–06MAY02–17/30

IMPORTANT: Inserting screwdriver blades farther than 1.6 mm (1/16 in.) may damage stator windings.

20. Carefully insert two screwdriver blades (A) in opposite openings between the stator and front housing and separate the front housing from the rear.

A—Two Screwdriver Blades

Insert Screwdriver Blades

Continued on next page

RG,RG34710,2073 –19–06MAY02–18/30

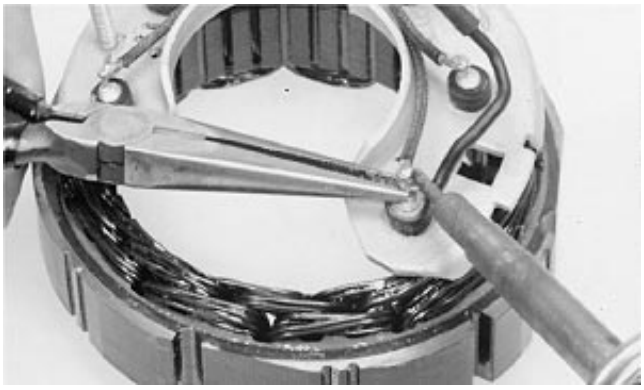
21. Put identification tags on wiring leads to aid assembly.

22. Unsolder wiring leads from diode leads, as necessary, to replace diode assemblies, diode trio or stator. Use needle-nose pliers as a heat sink on the leads of good diodes to protect them from too much heat.

    Remove nut and insulating washers from regulator terminal stud to remove diode trio from positive diode assembly plate. Note location of insulating washers for reassembly.

23. When soldering wiring leads to diodes, use needle nose pliers as a heat sink to protect diodes from too much heat. Use rosin core solder only.

24. Be sure to install insulating washer under nut when diode trio is installed.



T89073 –UN–21FEB90

Unsolder Wiring Leads

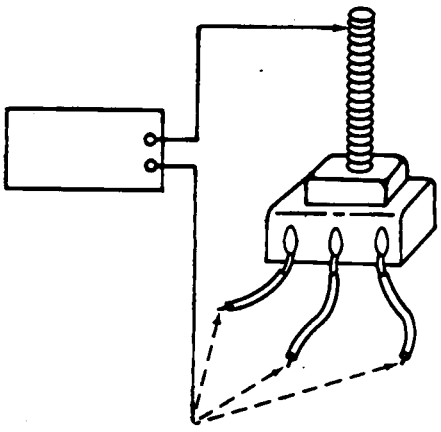
15
15
13

RG,RG34710,2073 –19–06MAY02–19/30

For alternators equipped with a diode trio:

25. Using a commercial diode tester, volt-ohm-amp meter with diode test position, or 12-volt DC test lamp, check for continuity from each lead separately to center contact stud. Continuity should be observed in one direction only. All three diodes should check alike.

26. If any diode is defective, replace entire diode trio assembly.



N38452 –UN–22SEP88

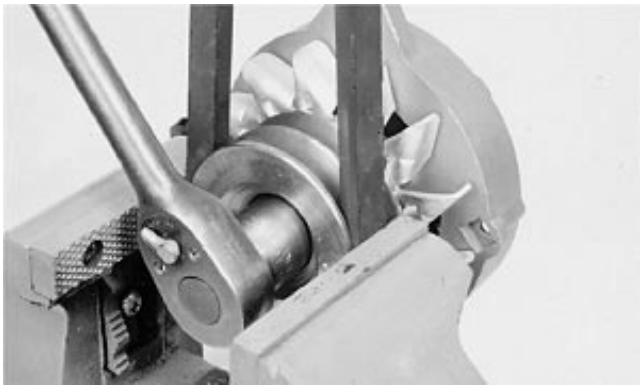
Commercial Diode Tester

Continued on next page

RG,RG34710,2073 –19–06MAY02–20/30

27. Clamp pulley in vise using an over-sized belt to protect pulley. Remove nut to remove pulley and fan.

    Inspect parts for wear or damage.

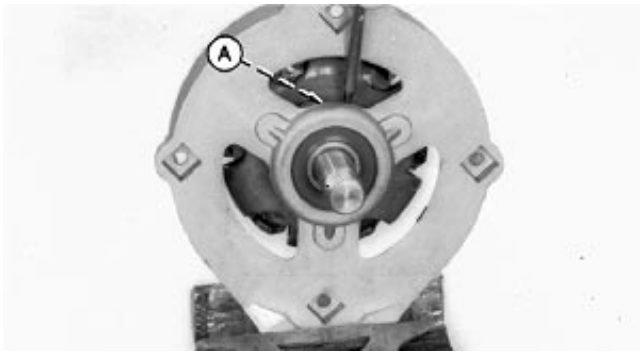


Remove Pulley and Fan

RG,RG34710,2073 –19–06MAY02–21/30

28. Remove the front bearing retainer (A) by compressing ears of bearing retainer with a long-nosed pliers and lifting retainer free of recess. On HC and MR units, remove three front bearing retainer screws and lock washers.

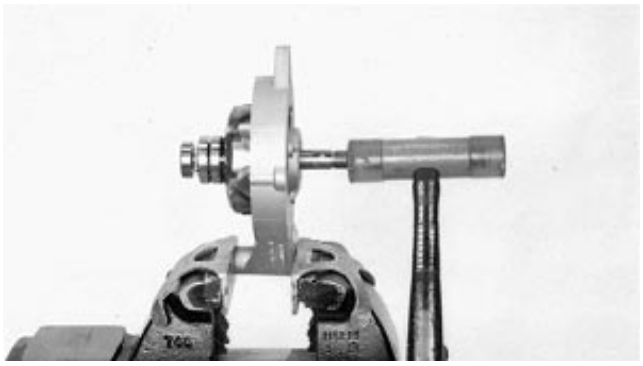
    A—Front Bearing Retainer



Remove Front Bearing Retainer

RG,RG34710,2073 –19–06MAY02–22/30

29. Use a plastic hammer to remove rotor and bearing from front housing. If front housing has felt dust seals pressed in casting, replace with new seals.

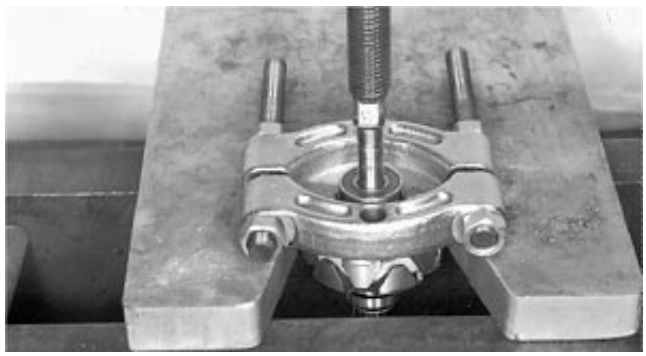


Remove Rotor and Bearing

Continued on next page

RG,RG34710,2073 –19–06MAY02–23/30

30. Use a suitable bearing puller to remove front bearing.



Remove Front Bearing

Continued on next page

RG,RG34710,2073 –19–06MAY02–24/30

15
15
15

31. Connect a voltmeter (A) to slip rings. (Make sure slip rings are clean.)

32. Connect an ammeter (D), a variable resistor (B), and 12-volt power source (C) in series. Attach to slip rings.

NOTE: Use a second volt-ohm-amp meter for the ammeter, and JT28001 Battery Load Tester as the variable resistor.

15
15
16

33. Set battery load tester to maximum resistance.

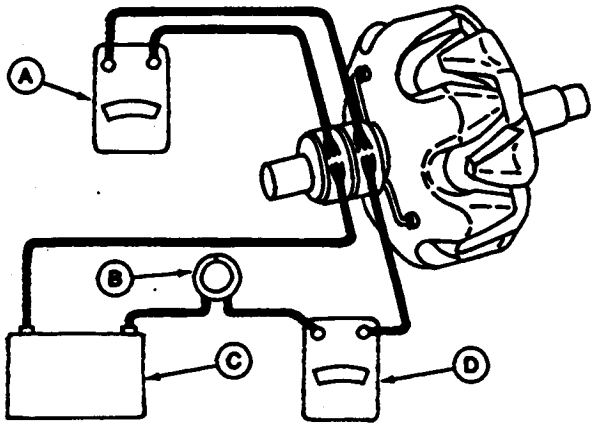
34. Connect other slip ring to the power source.

35. Adjust battery load tester to obtain full battery voltage.

IMPORTANT: Do not remove rotor leads from slip rings at this time. It will cause an arc, damaging slip ring surface.

ROTOR WINDING TEST SPECIFICATIONS [Measured at 21—27°C (70—80°F)]			
System Voltage	**Rated Amps**	**Current Draw (Amps)[a]**	**Winding Resistance (Ohms)**
12	37	1.95—2.55	4.2—5.5
12	51/55	1.65—2.55	4.0—5.2
12	62	2.1—2.5	4.1—4.7
12	72	1.8—2.0	5.0—5.4
12	90	4.1—4.4	2.3—2.4
24	42	1.28—1.88	11.0—14.0
[a]Current draw at 10V for 12-Volt systems and 20V for 24-Volt systems.			

Shorted windings are indicated by excessive current draw, and open windings by no current draw.



N37053 –UN–22SEP88

Voltmeter and Ammeter

A—Voltmeter
B—Variable Resistor
C—12-Volt Power Source
D—Ammeter

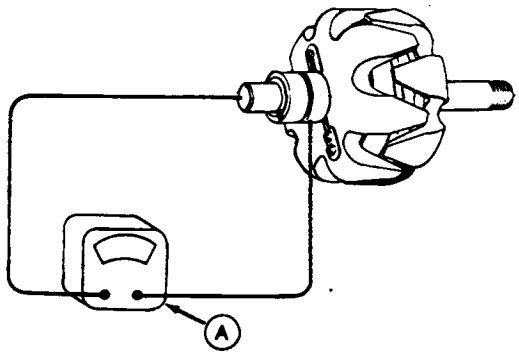
Continued on next page

RG,RG34710,2073 –19–06MAY02–25/30

36. Check rotor for grounds between each slip ring and rotor shaft, using ohmmeter (A) or test lamp.

    Ohmmeter resistance reading should be high (infinite) or test lamp should not light. If resistance is low or test lamp lights, short exists between field coil and rotor. Replace rotor.

    A—Ohmmeter



N35990 –UN–22SEP88

Ohmmeter or Test Lamp

15
15
17

RG,RG34710,2073 –19–06MAY02–26/30

37. Inspect rotor shaft and body for stripped threads on shaft, worn key slot, worn bearing surface, scuffed pole fingers, or worn or dry bearing.

    Replace rotor assembly if any of the above faults are found.

NOTE: New rotors include new rear bearings and slip rings.

38. Unsolder rotor leads from slip ring terminals.

IMPORTANT: Do not overheat slip ring terminals.

39. Carefully unwind ends of rotor coil leads from slip ring terminals.

N85162O1 –UN–22SEP88

Inspect Rotor Shaft and Body

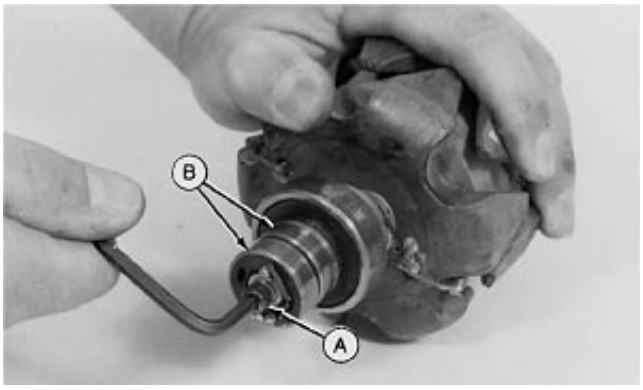
Continued on next page

RG,RG34710,2073 –19–06MAY02–27/30

40. Remove hex countersunk head screw (A) from end of shaft.

41. Thread a 1/4 x 1 in. cap screw into slip ring hub. This will back slip ring assembly (B) off shaft.

A—Hex Countersunk Head Screw
B—Slip Ring Assembly



N85162P1 –UN–22SEP88

Remove Screw and Slip Ring Assembly

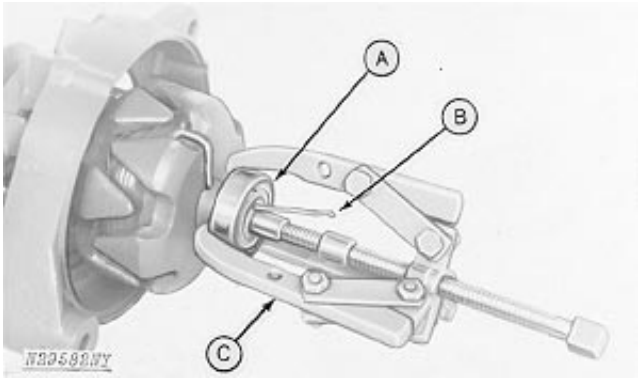
RG,RG34710,2073 –19–06MAY02–28/30

42. Place rotor leads (B) away from bearing puller contact area.

43. Using bearing puller (C), remove rear bearing (A).

NOTE: Remove bearing only if it will be replaced.

A—Rear Bearing
B—Rotor Leads
C—Bearing Puller



N29582NY –UN–03MAR89

Remove Rear Bearing

Continued on next page

RG,RG34710,2073 –19–06MAY02–29/30

44. Examine stator for discoloration or a burned odor indicating overheating from shorted windings. Stator should be checked further with low resistance (0—1 ohm) ohmmeter before it is replaced.

45. Disconnect stator leads from diode assemblies and check resistance from each lead to stator frame. If reading is not infinite, a winding is grounded.

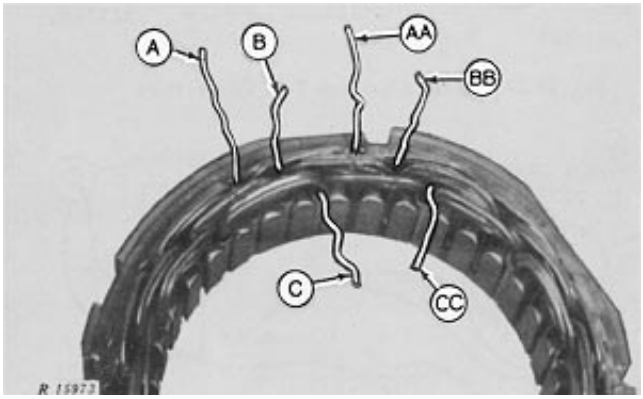
46. Carefully zero the ohmmeter and connect the leads between A and B.

    The meter reading should be 0.6 ohms. An infinite or high reading indicates an open-circuited winding.

47. While measuring the resistance between A and B, touch AA and BB leads together. If ohmmeter pointer does not drop to 0, the windings are shorted.

48. Repeat steps 3 and 4 with leads connected to A and C, then to B and C.

49. When replacing stator, connect leads A to B, AA to C, and BB to CC. Connect to diode assemblies.



R15973 –UN–15DEC88

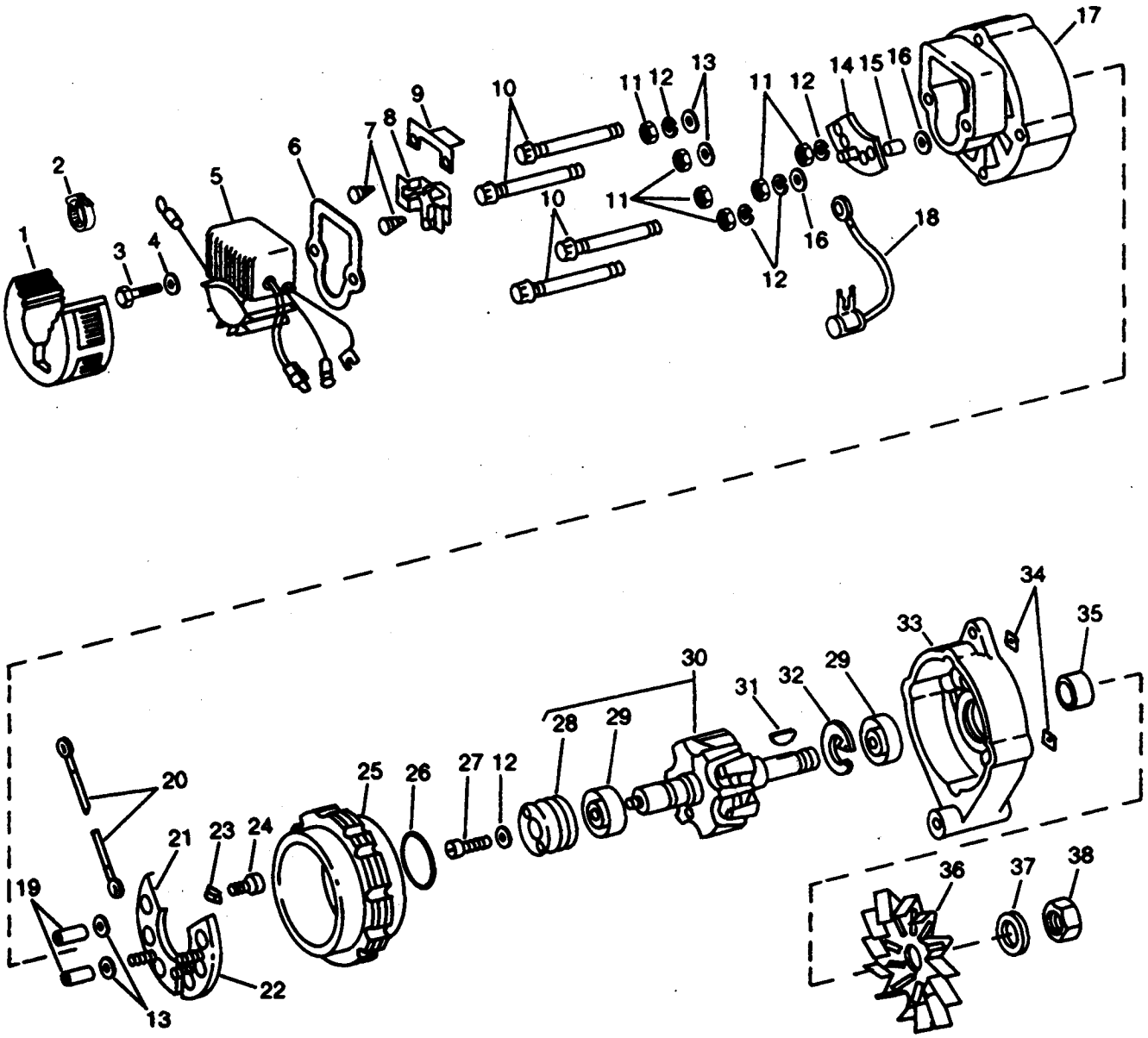
15
15
19

Stator Leads

A—Stator Lead
B—Stator Lead
C—Stator Lead
AA—Stator lead
BB—Stator Lead
CC—Stator Lead

RG,RG34710,2073 –19–06MAY02–30/30

Assemble Motorola HC-, MA-, MR-Series Alternator

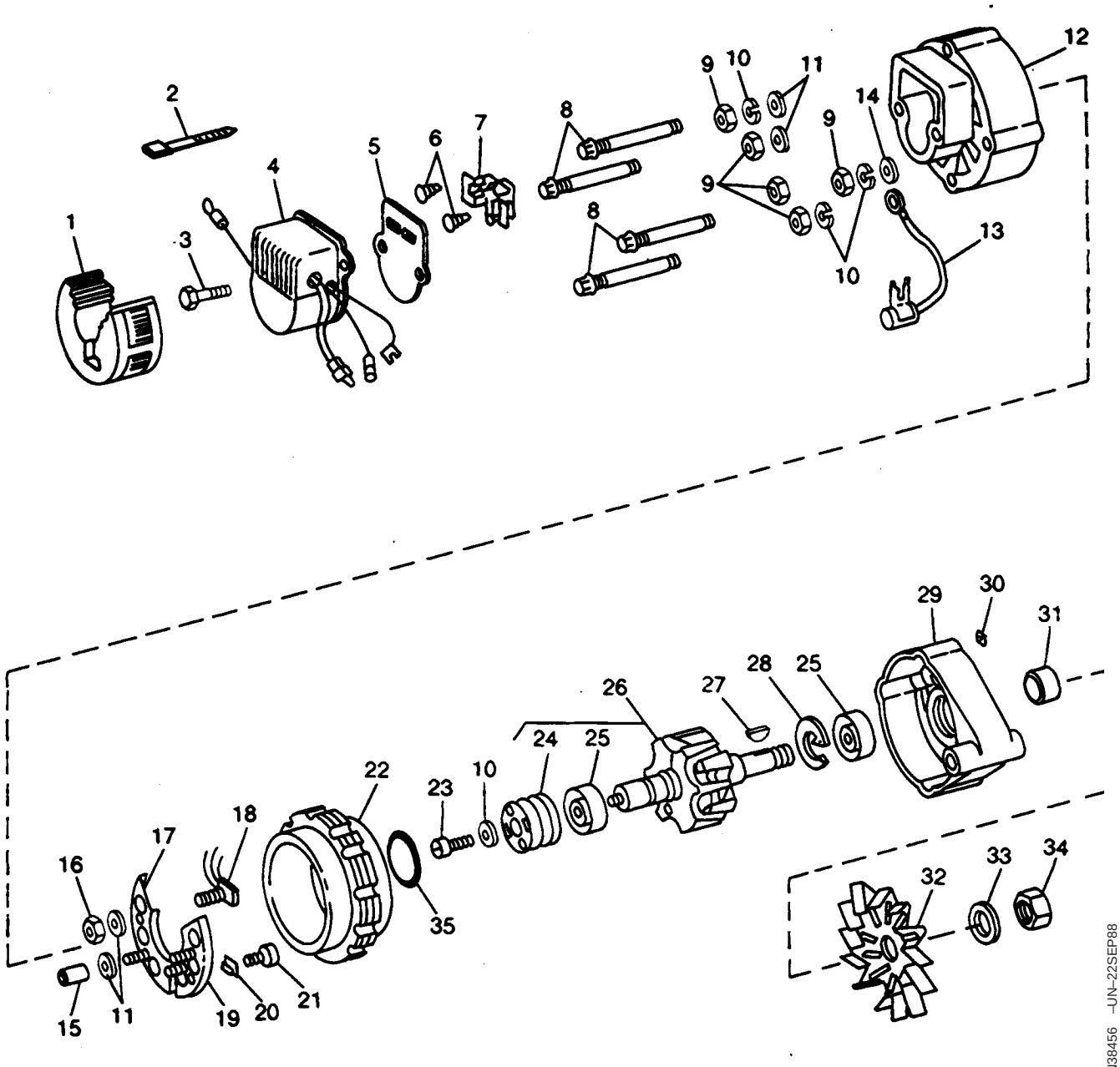


HC-, MA-, MR-Series with Isolation Diode

1—Cover
2—Tie Strap
3—Screw (2 Used)
4—Lock Washer (2 Used)
5—Regulator
6—Gasket
7—Screws (2 Used)
8—Brush Holder
9—Isolator
10—Through Bolts (4 Used)
11—Nut (6 Used)
12—Lock Washer (5 Used)
13—Washer (4 Used)
14—Diode, Isolation
15—Sleeve
16—Washer (2 Used)
17—Housing
18—Capacitor
19—Bushing (2 Used)
20—Wiring Lead
21—Positive Ring
22—Negative Ring
23—Insulator
24—Bolt
25—Stator
26—O-Ring
27—Screw
28—Ring
29—Bearing (2 Used)
30—Rotor
31—Key
32—Retainer
33—Housing
34—Nut (4 Used)
35—Spacer
36—Fan
37—Lock Washer
38—Nut

Continued on next page

RG,RG34710,2074 –19–15MAR97–1/21



HC-, MA-, MR-Series with Diode Trio

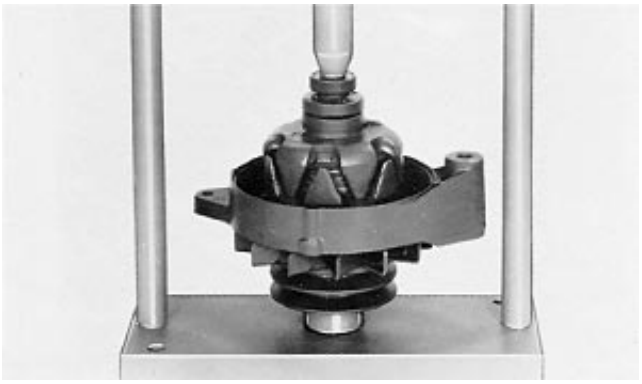
1—Screen
2—Tie Strap
3—Screw (4 Used)
4—Regulator
5—Gasket
6—Screws (2 Used)
7—Brush Holder
8—Through Bolts (4 Used)
9—Nuts (5 Used)
10—Lock Washer (6 Used)
11—Isolation Washer (7 Used)
12—Rear Housing
13—Capacitor
14—Washer
15—Spacer
16—Nuts (2 Used)
17—Diode Plate
18—Diode Trio
19—Rectifier Diode
20—Isolation Diode
21—Bolt
22—Stator
23—Screw
24—Slip Rings
25—Bearing (2 Used)
26—Rotor Assembly
27—Key
28—Retainer
29—Front Housing
30—Square Nuts
31—Spacer
32—Fan
33—Washer
34—Nut
35—O-Ring

Continued on next page

1. Support pulley end of rotor on base of press assembly.

NOTE: Use new front and rear bearings for reassembly of alternator.

2. Using push-puller, leg extensions, and bearing puller attachment, and pressing only on inner bearing race, press bearing on shaft until inner race contacts the shaft shoulder.



N38455 –UN–22SEP88

Install Bearing

RG,RG34710,2074 –19–15MAR97–3/21

3. Guide rotor windings through one passage in slip ring hub.

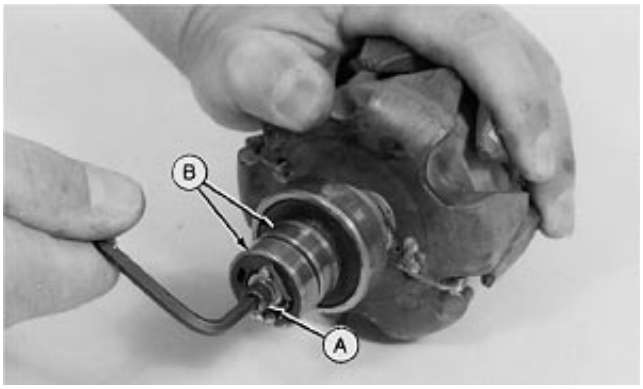
4. Hand press slip rings (B) on shaft while maintaining alignment of winding leads and passage.

5. Tighten hex countersunk head screw (A) to specifications.

Specification

Slip Ring Retainer Cap Screw—
Torque ..... 5.1 N•m (45 lb-in.)

A—Hex Countersunk Head Screw
B—Slip Rings



N85162P1 –UN–22SEP88

Slip Rings and Head Screw

Continued on next page

RG,RG34710,2074 –19–15MAR97–4/21

6. Install a fiber washer on the non-soldered terminal of slip rings. This is to prevent the inner slip ring from touching the outer slip ring, causing a short.

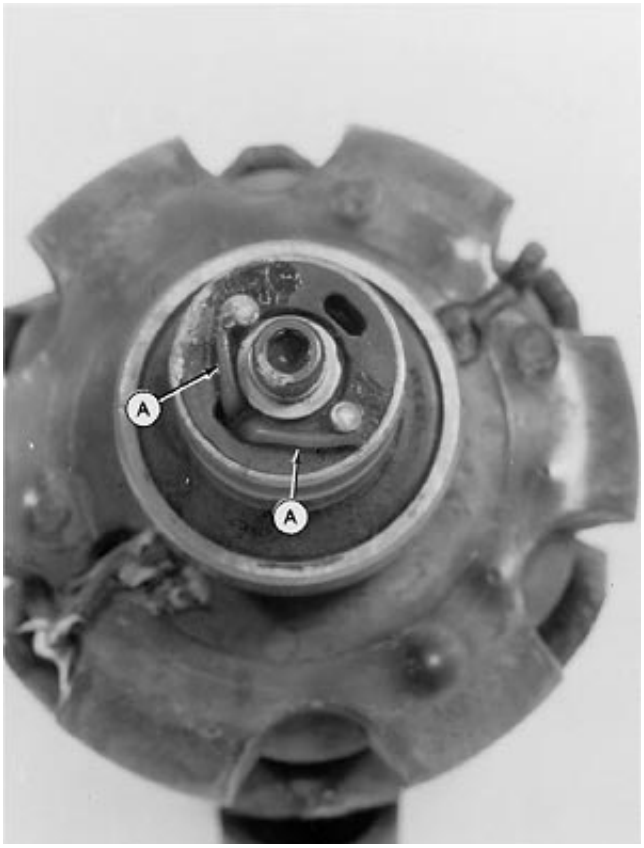
7. Wrap leads (A) around slip ring terminals, and solder with rosin core solder. Do not overheat.

IMPORTANT: ONLY rosin core solder should be used for soldering operations. The use of acid core solder will result in rapid corrosion of the windings and eventual failure of the complete alternator unit.

8. Secure wires to end of rotor with a synthetic sealer.

9. Retest rotor assembly to ensure that a ground or short circuit did not develop during repair.

A—Wire Leads



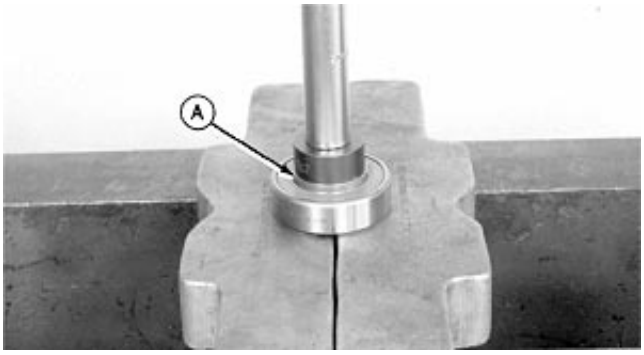
N85162Q1 –UN–22SEP88

Wrap Leads around Slip Ring Terminals

RG,RG34710,2074 –19–15MAR97–5/21

10. For MA and MR units, install sleeve (A) into either side of front ball bearing using a 32 mm disk. Push flange of sleeve tight against bearing race.

A—Sleeve



T84586 –UN–07NOV88

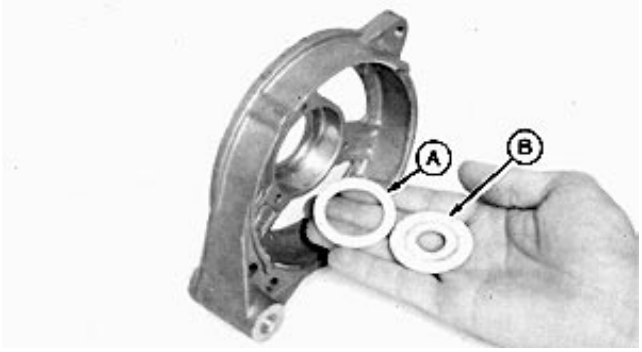
Install Sleeve

Continued on next page

RG,RG34710,2074 –19–15MAR97–6/21

11. Install felt seal (A) and washer (B) (if used) into front housing.

A—Felt Seal
B—Washer



Install Felt Seal and Washer

RG,RG34710,2074 –19–15MAR97–7/21

12. Install front ball bearing (A) into front housing so sleeve flange is toward rotor. Push bearing to the bottom of bore.

A—Front Ball Bearing

Install Front Ball Bearing

RG,RG34710,2074 –19–15MAR97–8/21

13. Place bearing retainer in housing recess, with ears upward and aligning them with opening in housing. Use a wooden dowel to exert pressure on retainer while locking retainer in recess.

Bearing Retainer in Housing Recess

Continued on next page

RG,RG34710,2074 –19–15MAR97–9/21

14. For HC and MR units, assemble front bearing and sleeve as follows:

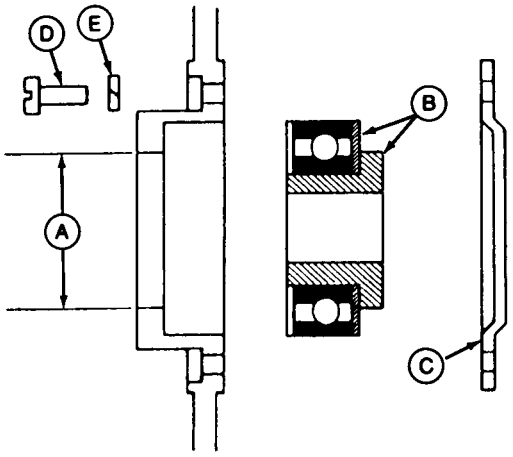
NOTE: There are two variations of assembly depending on the dimension (A).

If the dimension of bore (A) is 35.6 mm (1.40 in.), install the front bearing and sleeve assembly (B) in the housing and secure with bearing retainer (C), three retainer screws (D) and lock washers (E).

If the dimension of bore (A) is 46.9 mm (1.847 in.), the felt seal (F) must be installed flush with outer surface of housing. Remove outer bearing seal (G) from bearing before installing bearing and sleeve assembly in housing. Place felt seal (H) against bearing retainer (C). Secure bearing retainer (C) with three retainer screws (D) and lock washers (E).

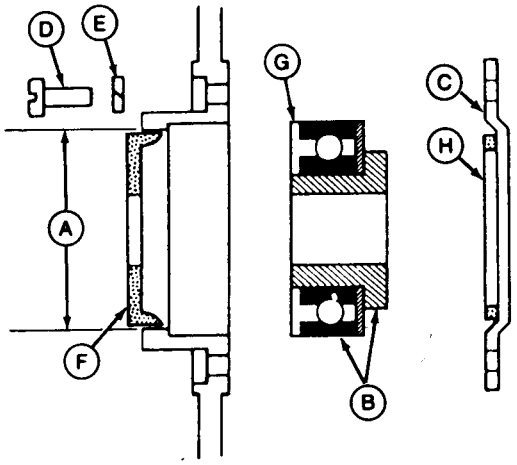
NOTE: Extra grease may be placed between the outer felt seal and the bearing.

A—Housing Bore Dimension
B—Bearing and Sleeve Assembly
C—Bearing Retainer
D—Retainer Screws
E—Lock Washers
F—Felt Seal
G—Outer Bearing Seal
H—Felt Seal



RG6995 –UN–10DEC93

35.6 mm (1.40 in.)

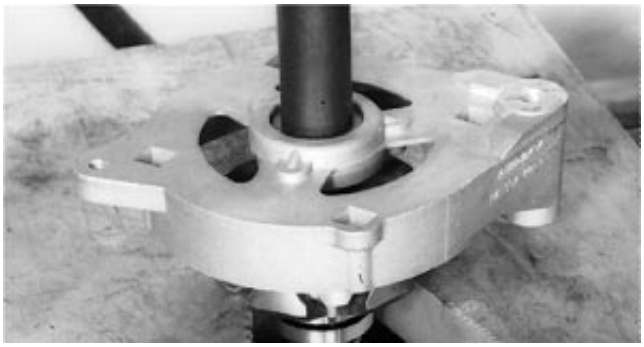


RG6996 –UN–10DEC93

46.9 mm (1.847 in.)

RG,RG34710,2074 –19–15MAR97–10/21

15. Using a hollow drive that contacts inner bearing race only, press front housing onto rotor shaft until bearing race contacts shaft shoulder.



T87610 –UN–23FEB90

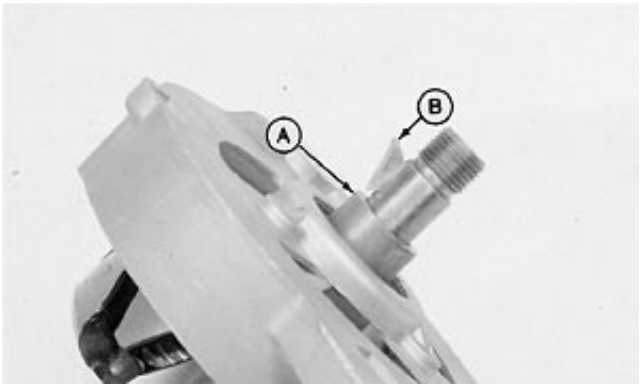
Press Front Housing onto Rotor Shaft

Continued on next page

RG,RG34710,2074 –19–15MAR97–11/21

16. Install spacer (A) and woodruff key (B).

A—Spacer
B—Woodruff Key



T89075 –UN–21FEB90

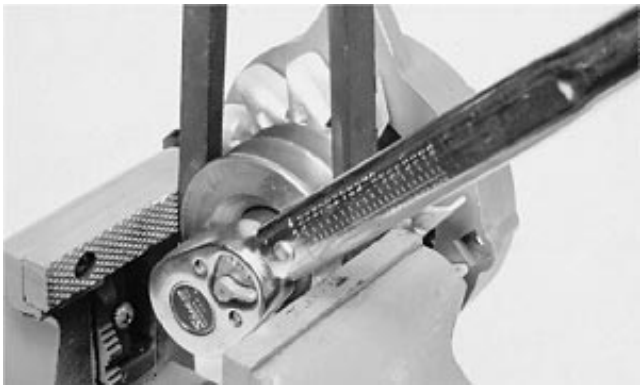
Install Spacer and Woodruff Key

RG,RG34710,2074 –19–15MAR97–12/21

17. Install fan, pulley, lock washer, and hex nut. Clamp pulley in vise using an old over-sized belt to protect pulley and tighten nut to specifications.

Specification

Fan Pulley-to-Shaft Nut—Torque ..... 47—68 N•m (35—50 lb-ft)



T89076 –UN–21FEB90

Tighten Nut

Continued on next page

RG,RG34710,2074 –19–15MAR97–13/21

18. Install O-ring. Lubricate the exposed area of the O-ring with hydraulic brake fluid only.

    DO NOT use oil.

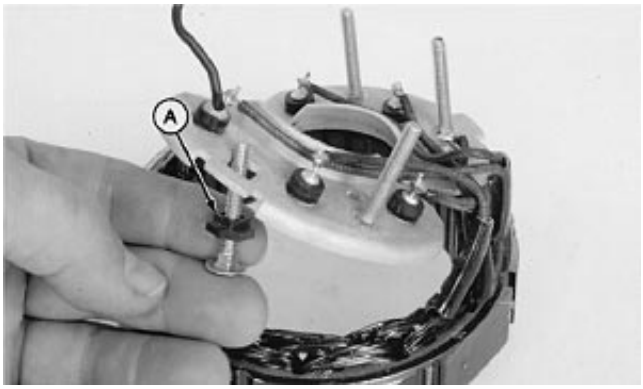
T6015AJ –UN–06APR90

Install O-Ring

RG,RG34710,2074 –19–15MAR97–14/21

19. Install insulator washer (A) and cap screw.

A—Insulator Washer



T89077 –UN–21FEB90

Install Insulator Washer and Cap Screw

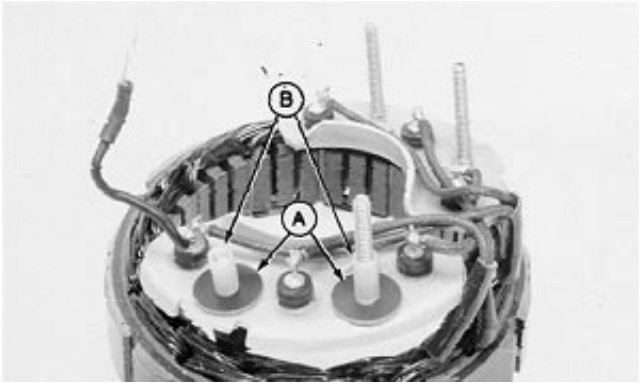
Continued on next page

RG,RG34710,2074 –19–15MAR97–15/21

20. Install insulator washers (A) and sleeves (B).

IMPORTANT: To prevent shorting or grounding, position stator leads away from through bolts and sharp corners of diode assemblies. Squeeze rear housing and stator together to check wire positions.

A—Insulator Washers
B—Sleeves



T89089 –UN–21FEB90

Insulator Washers and Sleeves

RG,RG34710,2074 –19–15MAR97–16/21

21. Install rear housing on stator.

22. Install capacitor, if equipped.

23. Install insulating washers (B), wire lead (A) and four nuts (C). Tighten nuts to specifications.

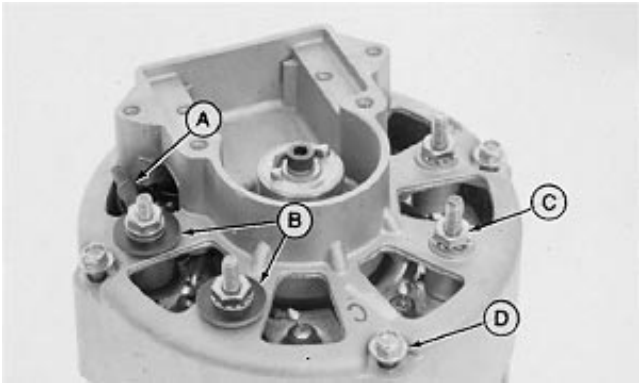
Specification	
Stator Stud Lock Nuts—Torque	3.5—4.5 N•m (33—40 lb-in.)

24. Install rear housing and stator on the front housing. Line up screw holes.

25. Install four through bolts (D) and square nuts, if used. Tighten bolts evenly to specifications.

Specification	
Housing Through Bolts—Torque	5.5—7.0 N•m (50—60 lb-in.)

NOTE: Spin rotor shaft by hand to ensure bearings are not binding.



T6015AR –UN–06APR90

Rear Housing

A—Wire Lead
B—Insulating Washers
C—Nuts (4 Used)
D—Through Bolts (4 Used)

Continued on next page

RG,RG34710,2074 –19–15MAR97–17/21

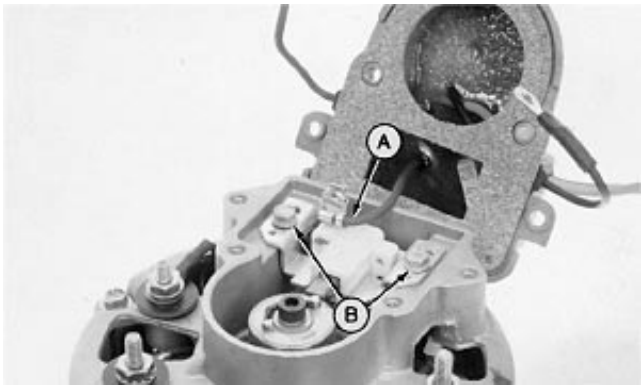
26. Install brush assembly (HC/MR unit shown).

27. Install and tighten screws (B) to specifications.

Specification	
Brush Assembly Mounting Screws—Torque	2.5—3.5 N•m (20—30 lb-in.)

28. Connect regulator wire (A) to brush terminal.

A—Regulator Wire
B—Screws (2 Used)



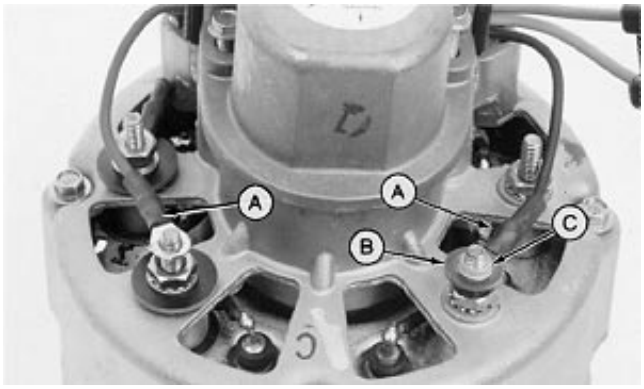
T6015AC –UN–06APR90

HC/MR Unit Shown

RG,RG34710,2074 –19–15MAR97–18/21

29. Install regulator wires (A). Install insulator washer (B) and sleeve (C).

A—Regulator Wires
B—Insulator Washer
C—Sleeve



T6015AT –UN–06APR90

Install Wires, Washer, and Sleeve

Continued on next page

RG,RG34710,2074 –19–15MAR97–19/21

30. Install isolation diode plate and insulation washer (B) at negative terminal, if equipped.

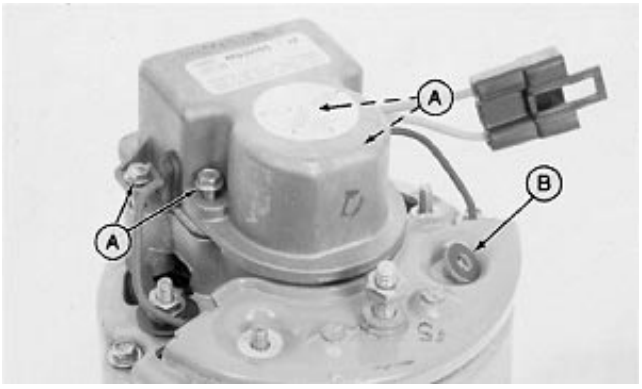
IMPORTANT: The negative terminal post must be isolated from diode plate.

31. Install and tighten regulator cap screws (A) to specifications.

	Specification
Regulator Mounting Cap Screws—Torque	4.5—5.0 N•m (40—45 lb-in.)

15
15
30

A—Regulator Cap Screws (4 Used)
B—Insulated Washer



T6015AK –UN–06APR90

Isolation Diode Plate/Insulation Washer

RG,RG34710,2074 –19–15MAR97–20/21

32. Install and tighten two isolation diode nuts to specifications.

	Specification
Isolation Diode Nuts—Torque	2.5—3.5 N•m (20—30 lb-in.)

33. Tighten alternator terminal nuts to specifications.

	Specification
Alternator Terminal Nuts—Torque	2.5—3.5 N•m (20—30 lb-in.)

T6015BI –UN–06APR90

Tighten Nuts

RG,RG34710,2074 –19–15MAR97–21/21

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B60 –19–08MAY02–1/3

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUO1004,0000B60 –19–08MAY02–2/3

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000B60 –19–08MAY02–3/3

Motorola A-, RA-, 8AR-Series Charging Circuit Repair Specifications

Item	Measurement	Specification
Used Brush	Minimum Exposed Length	6.4 mm (0.25 in.)
Housing Through Bolts	Torque	3.5—4.0 N•m (30—35 lb-in.)
Pulley Shaft Nut	Torque	68 N•m (50 lb-ft)

OUO1004,0000B63 –19–21SEP00–1/1

Motorola A-, RA-, 8AR-Series Charging Circuit Test Specifications

John Deere Part No.	Motorola Part No.	Volts	Rated Amps	Output Test[a] Amps (Hot)	Field Current[b] Amps	Winding Resistance[c] Ohms
A221618	A12NJD454	12	35	—	—	—
AR38458	RA12NJD453, 70D44120C01	12	35	33	1.90—2.55	4.2—5.5
AR40419	RA2AJD9025, A24JD900	24	35	—	1.28—1.88	—
AR40420	RA12NJD604	12	55	52	1.65—2.25	4.0—5.2

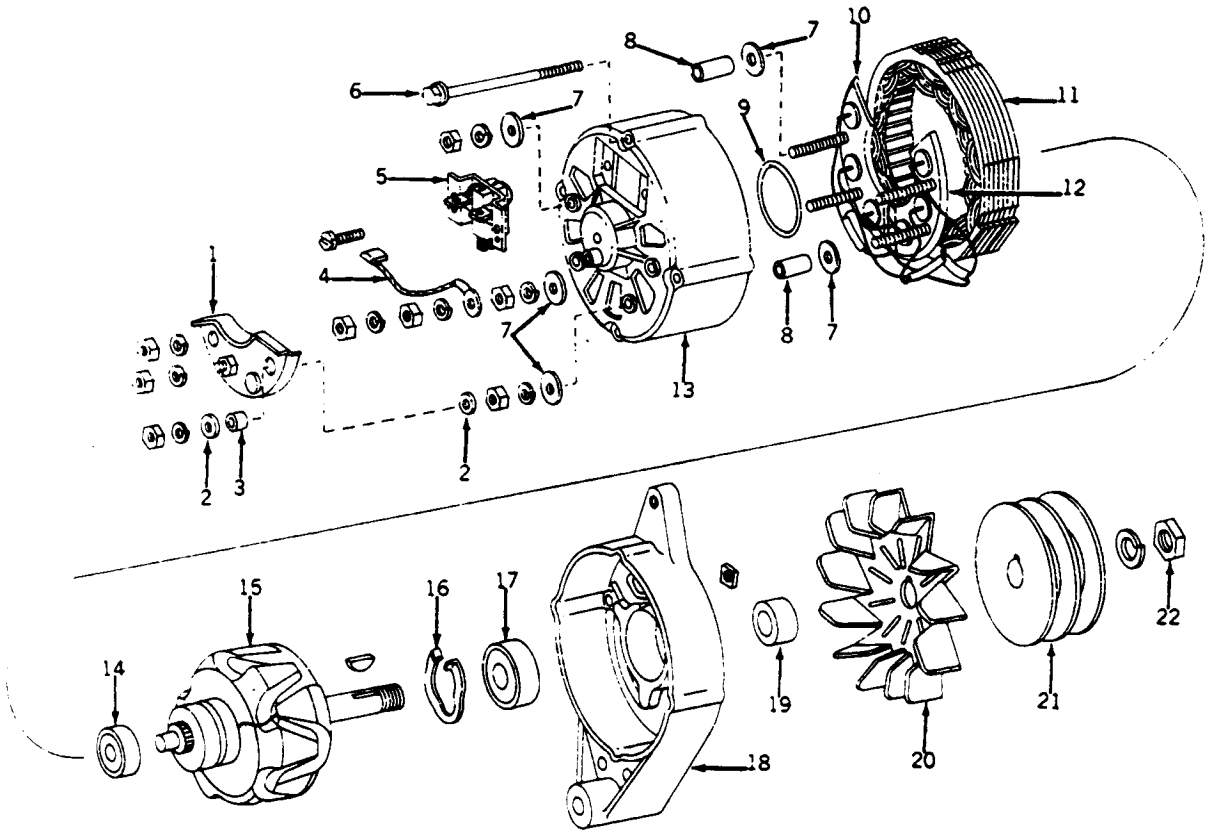
[a]Output test @ 3000—5000 RPM.

[b]Field current @ 20—27°C (70—80°F); @ 10V for 12V systems and 20V for 24V systems.

[c]Winding resistance @ 20—27°C (70—80°F).

RG,RG34710,2076 –19–08SEP00–1/1

Disassemble and Test Motorola A-, RA-, 8AR-Series Alternator



RG5477 –UN–02FEB89

Motorola A-, RA-, 8AR-Series Alternator

1—Isolation Diode Plate
2—1/2 in. Insulating Washer
3—Short Insulating Bushing
4—Brush Return Wire
5—Brush Holder
6—Through Bolt
7—3/4 in. Insulating Washer
8—Long Insulating Bushing
9—O-Ring Bearing Retainer
10—Positive Diode
11—Stator
12—Negative Diode
13—Slip Ring End Frame
14—Slip Ring End Bearing
15—Rotor
16—Bearing Retainer
17—Drive End Bearing
18—Drive End Frame
19—Spacer
20—Fan
21—Pulley
22—Pulley Nut

The regulator (not shown) may be mounted directly to end frame (13) or remotely mounted elsewhere on the vehicle.

Continued on next page

RG,RG34710,2077 –19–15MAR97–1/15

1. Check isolation diode plate using digital multimeter with selector indicator in the diode test position.

   The meter must register “OL” in one direction and approximately 0.50 volts in the other. If it does not, replace diode.

Check Isolation Diode Plate

RG,RG34710,2077 –19–15MAR97–2/15

2. Test the three negative diodes (A) with selector in diode test position.

   Touch one probe to a diode (A) and the other probe to the ground terminal. Take reading. Reverse probes and take another reading.

   The meter must register “OL” in one direction and approximately 0.50 volts in the other on all three diodes. If it does not, replace the negative diode plate.

   A—Three Negative Diodes

Test Negative Diodes

Continued on next page

RG,RG34710,2077 –19–15MAR97–3/15

3. Test the three positive diodes (A) with selector in diode test position.

   Touch one probe to a diode (A) and the other probe to diode plate post. Take reading. Reverse probe and take another reading.

   The meter must register “OL” in one direction and approximately 0.50 volt in the other on all three diodes. If it does not, replace the positive diode plate.

   A—Three Positive Diodes

Test Positive Diodes

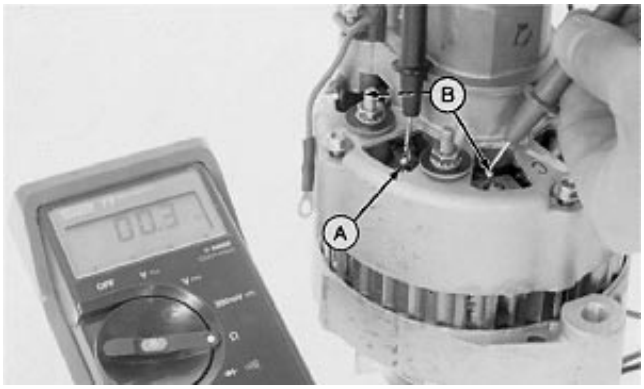
RG,RG34710,2077 –19–15MAR97–4/15

4. Check the stator windings for continuity.

   Touch one probe to a diode (A) and the other probe to each of the other two diodes (B) attached to the same diode plate. Repeat step for other diode plate.

   If there is no continuity in any of the connections, there is an open circuit in the stator windings and the stator must be replaced.

   A—Diode
   B—Two Diodes



Check Stator Windings for Continuity

Continued on next page

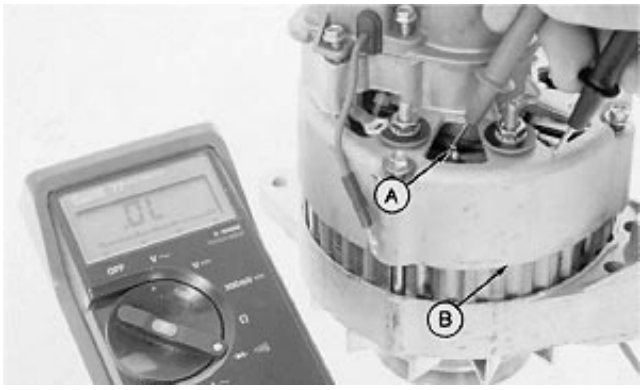
RG,RG34710,2077 –19–15MAR97–5/15

5. Check stator for a grounded winding.

   Touch one probe to diode lead (A) and the other probe to the rear alternator housing (B). Take reading. Reverse the probes and take another reading.

   The meter must register in one direction only. If continuity is registered in both directions, a stator winding is grounded and the stator must be replaced.

A—Diode Lead
B—Rear Alternator Housing



T6015BA –UN–06APR90

Check Stator for Grounded Winding

RG,RG34710,2077 –19–15MAR97–6/15

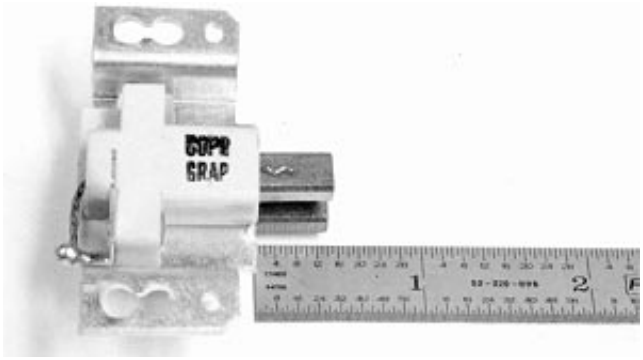
6. Remove regulator from end frame, if so equipped. Remove brush cover.

7. Remove two cap screws to remove brushes.

8. Check the condition of the springs and connections, and for freedom of movement of brushes. If either brush is worn beyond specification, or is cracked or oil soaked, replace the brush assembly.

Specification

Used Brush—Minimum Exposed Length..... 6.4 mm (0.25 in.)



T84656 –UN–07NOV88

Brush Assembly

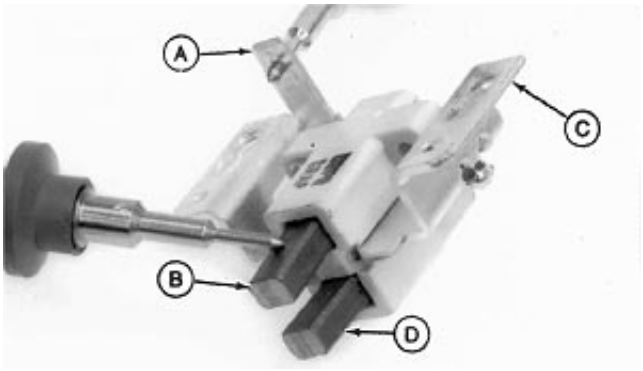
Continued on next page

RG,RG34710,2077 –19–15MAR97–7/15

9. Check for continuity between terminal (A) and brush (B). Next check for continuity between bracket (C) and brush (D). If there is no continuity at either brush, replace the brush assembly.

10. Check for continuity between terminal (A) and bracket (C). If there is continuity, replace the brush assembly.

A—Terminal
B—Brush
C—Bracket
D—Brush



T87568 –UN–23FEB90

Check for Continuity

RG,RG34710,2077 –19–15MAR97–8/15

11. Remove four through bolts and nuts.

IMPORTANT: Inserting screwdriver blades deeper than 1.6 mm (1/16 in.) may damage stator windings.

12. Carefully insert two screwdriver blades (A) in opposite openings between the stator and front housing to separate the front housing from the rear.

A—Two Screwdriver Blades

T87572 –UN–23FEB90

Insert Screwdriver Blades

Continued on next page

RG,RG34710,2077 –19–15MAR97–9/15

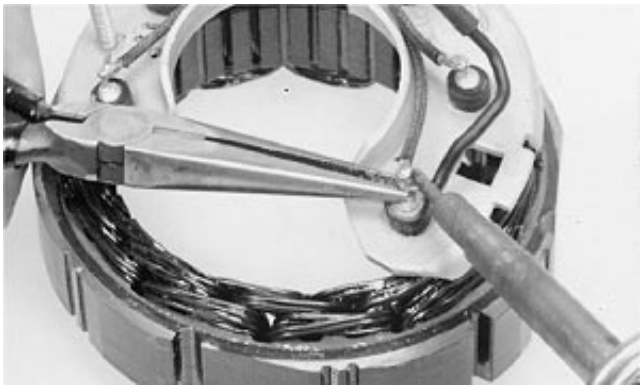
13. Remove stator and diode assembly from the slip ring end frame.

14. If necessary to remove diodes from stator, carefully note locations of insulators and washers for proper reassembly. Do not unsolder stator-to-diode wire junctions. Avoid bending stator wires at junction.

IMPORTANT: Do not use an acid-core solder when soldering diode leads. Use rosin-core solder only.

15. Use needle-nose pliers as a heat sink when soldering and unscrewing leads to and from diodes. Do not exert excessive stress on diode leads.

16. Note diode assembly-to-stator connections. Be sure replacement diode assembly connections are the same as removed. The positive diode assembly has red printing and the negative has black printing. DO NOT INTERCHANGE.



Soldering and Unscrewing Leads

RG,RG34710,2077 –19–15MAR97–10/15

17. Use a bearing puller to remove slip ring end bearing. If bearing is to be reused, puller must contact inner race only.

Remove Slip Ring End Bearing

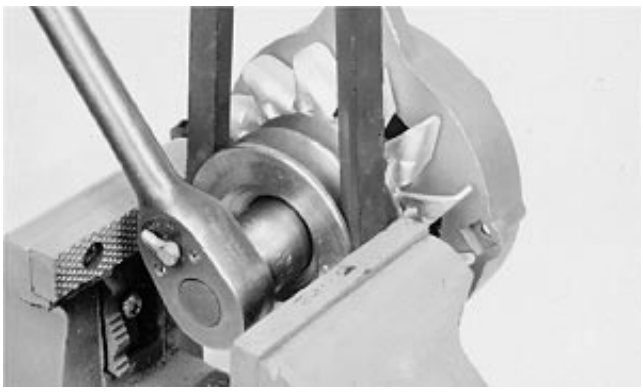
Continued on next page

RG,RG34710,2077 –19–15MAR97–11/15

18. Remove nut to remove pulley and fan. Clamp pulley in vise using an old over-sized belt to protect pulley. Remove woodruff key from shaft.

    Inspect parts for wear or damage.

NOTE: Pulley nut need not be removed if front bearing will not be replaced.

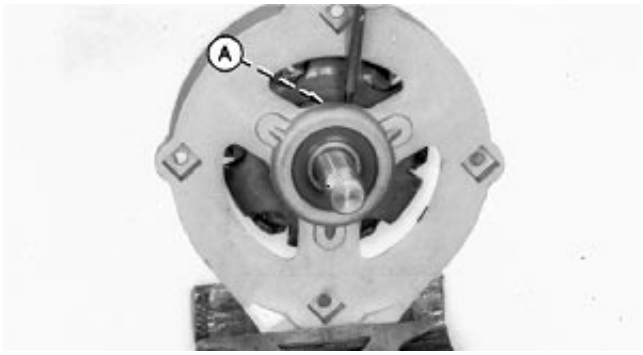


Remove Pulley and Fan

RG,RG34710,2077 –19–15MAR97–12/15

19. Remove the front bearing retainer (A) by prying it out of its groove with an awl.

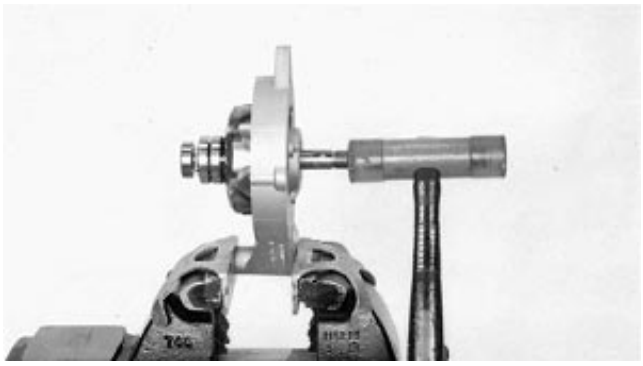
A—Front Bearing Retainer



Remove Front Bearing Retainer

RG,RG34710,2077 –19–15MAR97–13/15

20. Use a plastic hammer to remove rotor and bearing from front housing.



Use Plastic Hammer

Continued on next page

RG,RG34710,2077 –19–15MAR97–14/15

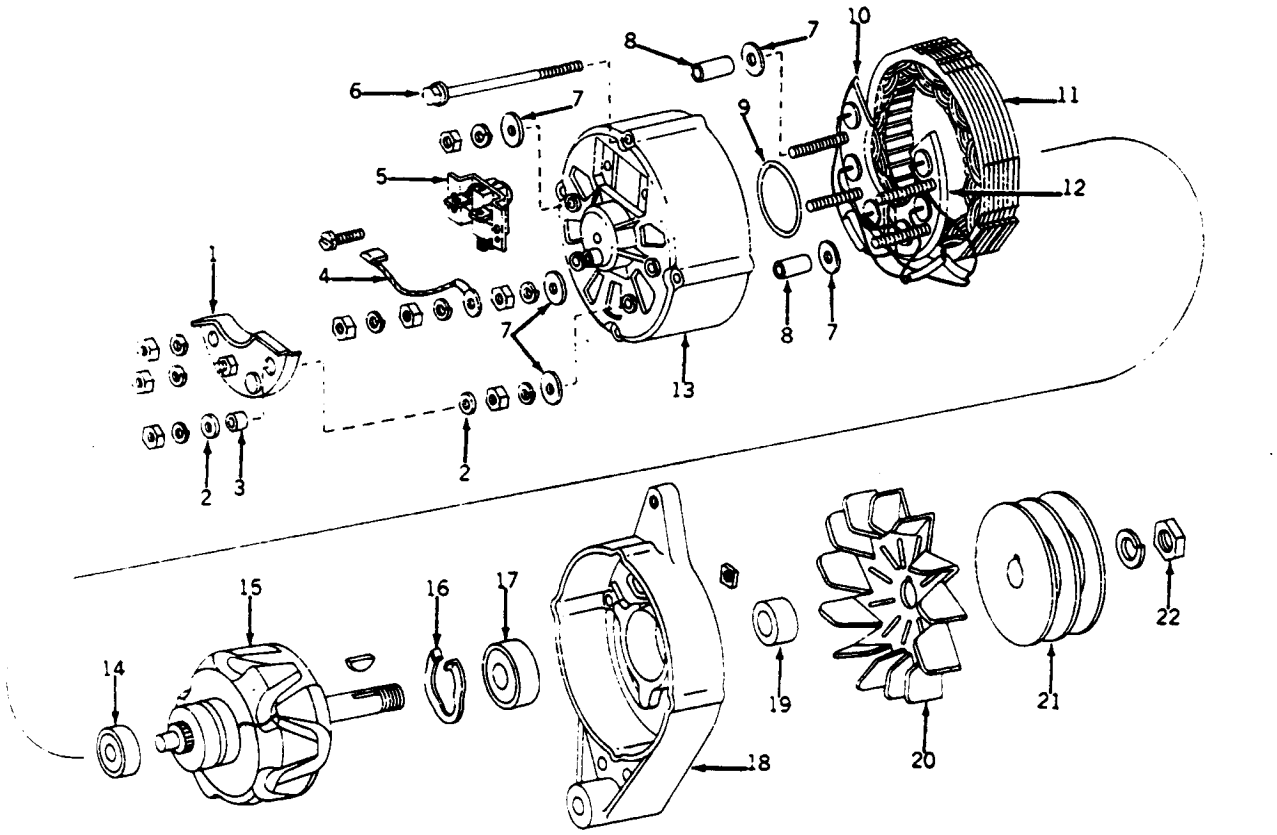
21. Use a suitable bearing puller to remove front bearing.

Remove Front Bearing

RG,RG34710,2077 –19–15MAR97–15/15

15
20
10

Assemble Motorola A-, RA-, 8AR-Series Alternator



Motorola A-, RA-, 8AR-Series Alternator

1—Isolation Diode Plate
2—1/2 in. Insulating Washer
3—Short Insulating Bushing
4—Brush Return Wire
5—Brush Holder
6—Through Bolt
7—3/4 in. Insulating Washer
8—Long Insulating Bushing
9—O-Ring Bearing Retainer
10—Positive Diode
11—Stator
12—Negative Diode
13—Slip Ring End Frame
14—Slip Ring End Bearing
15—Rotor
16—Bearing Retainer
17—Drive End Bearing
18—Drive End Frame
19—Spacer
20—Fan
21—Pulley
22—Pulley Nut

For alternator assembly, the following is a list of special requirements:

Replace bearings, if removed.

Guide rotor leads through one of the oval passages in the slip ring assembly. The oval passage must line up with the groove in the rotor shaft.

Press front housing down until inner bearing race contacts shoulder on shaft.

Be sure front bearing retainer is firmly seated in housing bore.

Tighten housing through bolts to specifications.

Specification	
Housing Through Bolts—Torque	3.5—4.0 N•m (30—35 lb-in.)

Continued on next page

RG,RG34710,2078 –19–15MAR97–1/2

Tighten pulley shaft nut to specifications.

Specification	
Pulley Shaft Nut—Torque	68 N•m (50 lb-ft)

RG,RG34710,2078 –19–15MAR97–2/2

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B64 –19–08MAY02–1/3

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUO1004,0000B64 –19–08MAY02–2/3

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000B64 –19–08MAY02–3/3

Other Material

Number	Name	Use
T43512 (U.S.) TY9473 (Canadian) 242 (LOCTITE®)	Thread Lock and Sealer (Medium Strength)	Apply to front and rear bearing retainer cap screws.

15
25
2

LOCTITE is a registered trademark of Loctite Corp.

OUO1004,0000B66 –19–21SEP00–1/1

Motorola SA-Series Charging Circuit Repair Specifications

Item	Measurement	Specification
Brush	Minimum Exposed Length	4.8 mm (0.189 in.)
Slip Ring Retainer Screw	Torque	5.1 N•m (45 lb-in.)
Pulley Retaining Nut	Torque	68 N•m (50 lb-ft)
Housing Through Bolts	Torque	5.7—6.8 N•m (50—60 lb-in.)

OUO1004,0000B67 –19–21SEP00–1/1

Motorola SA-Series Charging Circuit Test Specifications

John Deere Part No.	Motorola Part No.	Volts	Rated Amps	Output Test[a] Amps (Hot)	Field Current[b] Amps	Winding Resistance[c] Ohms
AT51042	8SA2016R	12	84	77—80	1.74—2.10	5.25
RE20486	8SA2035V	12	130	100—110	3.90—4.70	2.30
[a]Output test @ 3000—4000 RPM.						
[b]Field current @ 20—27°C (70—80°F); @ 10V for 12V systems and 20V for 24V systems.						
[c]Winding resistance @ 20—27°C (70—80°F).						

Item	Specification
Stator Resistance	0.1—0.4 ohms
130 Amp Rotor Winding Resistance	2.0—3.0 ohms
84 Amp Rotor Winding Resistance	4.7—5.8 ohms

15
25
3

RG,RG34710,2080 –19–08SEP00–1/1

Remove Alternator for Repair

Refer to your machine technical manual for removal of alternator.

IMPORTANT: Never immerse alternator in cleaning solvent. Remove dirt and grease by scraping and using a stiff brush with solvent. Dry with compressed air.

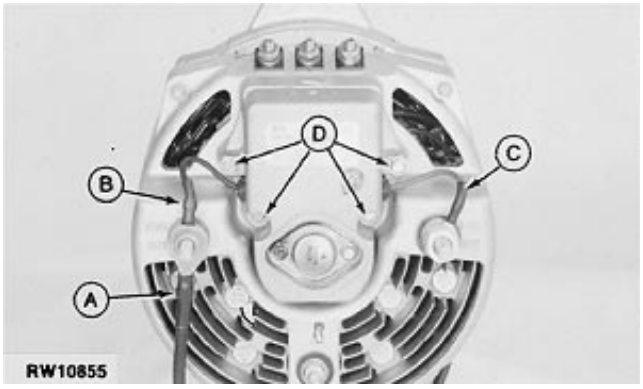
ONLY rosin core solder should be used for soldering operations. The use of acid core solder will result in rapid corrosion of the windings and eventual failure of the complete alternator unit.

RG,RG34710,2081 –19–15MAR97–1/1

Disassemble and Test Motorola SA-Series Alternator

1. Remove alternator ground wire (A), regulator ground lead (B) and regulator positive lead (C).
2. Remove regulator retaining cap screws (D).
3. Remove yellow wire leads from stator terminals and green wire leads from brush terminals.

A—Alternator Ground Wire
B—Regulator Ground Lead
C—Regulator Positive Lead
D—Cap Screws



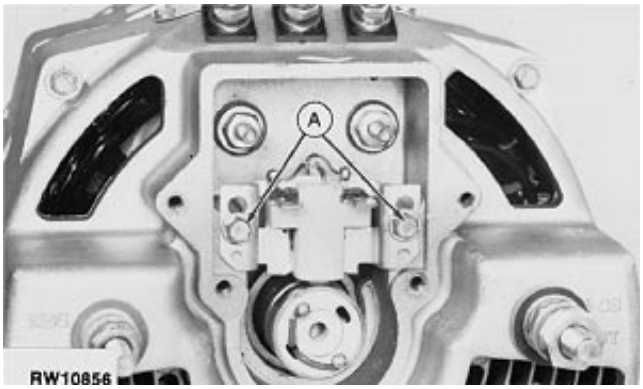
RW10855 –UN–17NOV89

Disassemble Motorola SA Alternator

RG,RG34710,2082 –19–09MAY02–1/22

4. Remove brush assembly retaining cap screws (A), then remove brush assembly.

A—Brush Assembly Retaining Cap Screws (2 Used)



RW10856 –UN–17NOV89

Brush Assembly Retaining Cap Screws

Continued on next page

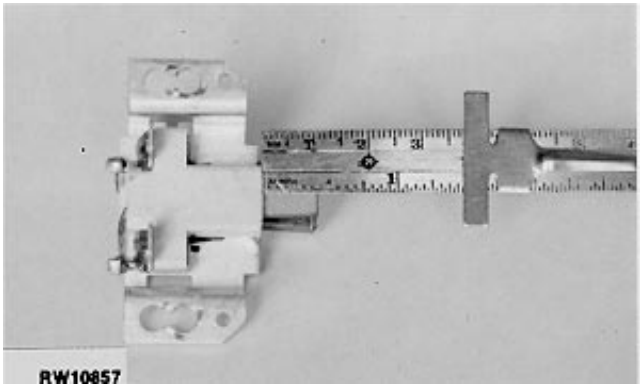
RG,RG34710,2082 –19–09MAY02–2/22

5. Examine brushes for roughness, cracks or oil contamination. If damaged, replace assembly.

6. Measure unused brush length. If brush length is not within specification, replace brushes.

Specification

Brush—Minimum Exposed Length..... 4.8 mm (0.189 in.)



RW10857 –UN–17NOV89

Measure Brush Length

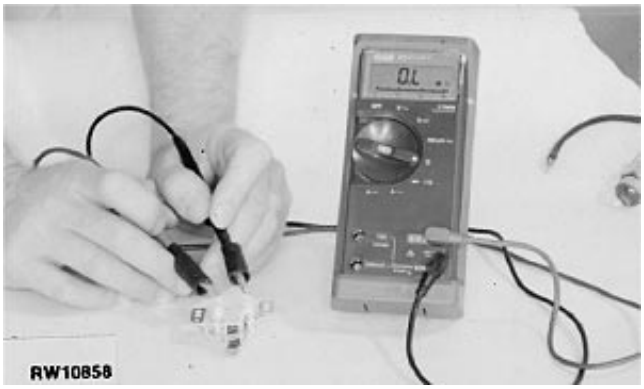
15
25
5

RG,RG34710,2082 –19–09MAY02–3/22

7. Use ohmmeter to test continuity between each terminal and attached brush.

8. Test continuity between the two brushes and between each brush and ground. There should be no continuity.

9. If malfunction was indicated in regulator or brush assembly, replace parts as necessary and reassemble. If not, continue disassembly.



RW10858 –UN–17NOV89

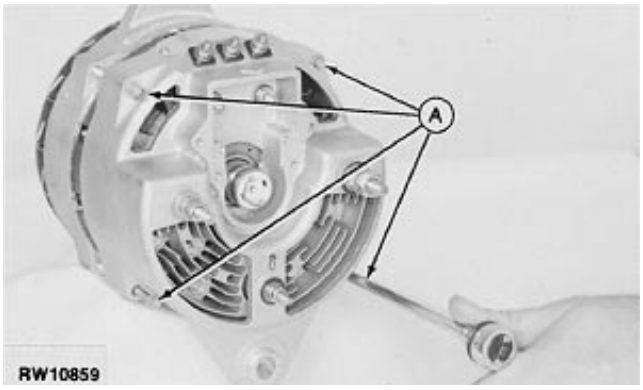
Use Ohmmeter to Test Continuity

Continued on next page

RG,RG34710,2082 –19–09MAY02–4/22

10. Remove four through bolts (A).

A—Through Bolts (4 Used)



RW10859 –UN–17NOV89

Remove Through Bolts

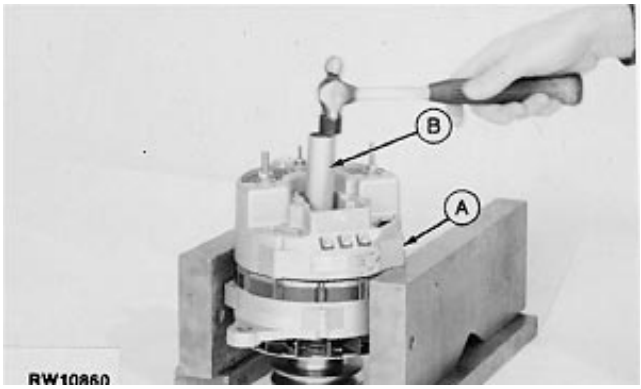
RG,RG34710,2082 –19–09MAY02–5/22

IMPORTANT: Avoid inserting sharp tools between stator and housing. Damage to stator windings or laminations could occur.

11. Separate front housing from rear housing by supporting rear housing at through bolt ears (A) with wood or steel blocks. Use 25.4 mm (1.0 in.) ID soft steel conduit (B) as a driver.

NOTE: Stator will stay with rear housing, rotor will stay with front housing.

A—Through Bolt Ears
B—Soft Steel Conduit Driver



RW10860 –UN–17NOV89

Separate Front Housing from Rear Housing

Continued on next page

RG,RG34710,2082 –19–09MAY02–6/22

12. Remove stator leads from the three stator tap terminals (A).
13. Remove the “R” terminal stud (B).
14. Remove stator (C) from rear housing.

A—Stator Tap Terminals (3 Used)
B—“R” Terminal Stud
C—Stator

RW10862 –UN–17NOV89

Remove Stator Leads

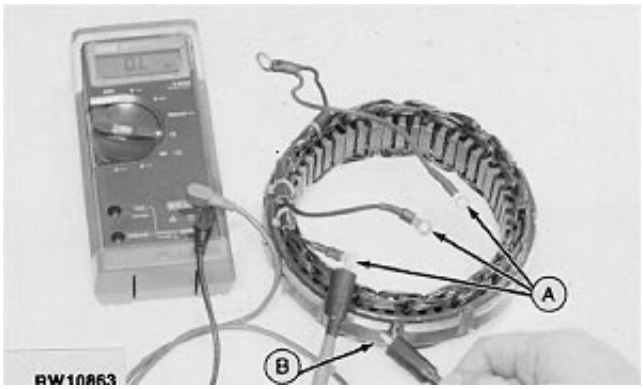
RG,RG34710,2082 –19–09MAY02–7/22

15. Inspect stator for physical damage. Look for broken insulation, rotor striking laminations or foreign material that may restrict circulation of cooling air.

    Discoloration or burned odor may indicate overheating, which may cause short circuits. Replace stator if either condition exists.

16. Connect ohmmeter to each stator lead (A) and stator frame (B). Replace stator if test indicated continuity.

A—Stator Leads
B—Stator Frame



RW10863 –UN–17NOV89

Inspect Stator Lead and Frame

Continued on next page

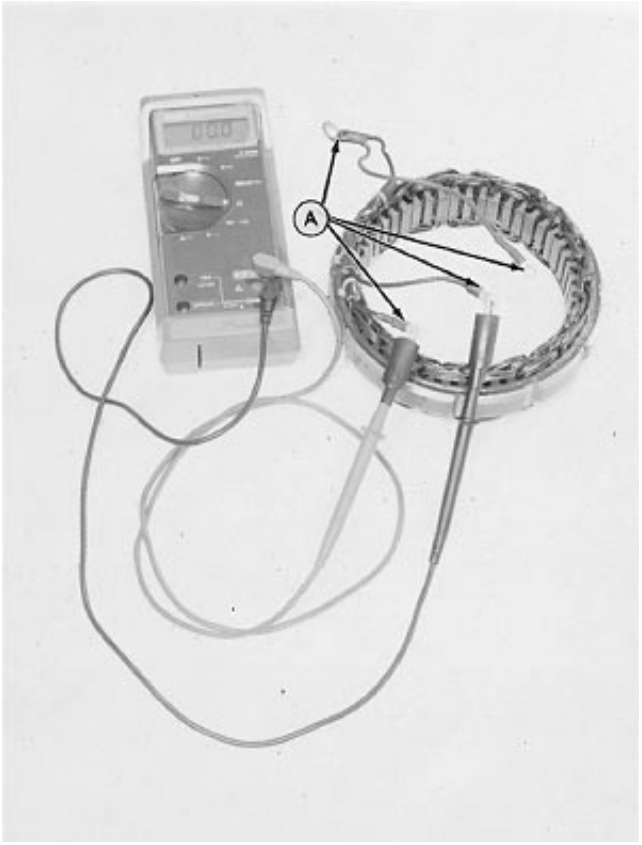
RG,RG34710,2082 –19–09MAY02–8/22

17. A short-circuit in the stator can be difficult to identify. Use an ohmmeter that is sensitive to resistance of 0 to 1 ohm.

    Connect ohmmeter between each pair of terminals (A). Resistance should be approximately 0.1 ohm. (Ohmmeter needle should deflect to zero if leads are touched together.) If resistance is above 0.4 ohm, replace stator.

    A stator will occasionally exhibit an open circuit or short circuit only when hot, making the defect even more difficult to diagnose.

    A—Stator Terminals



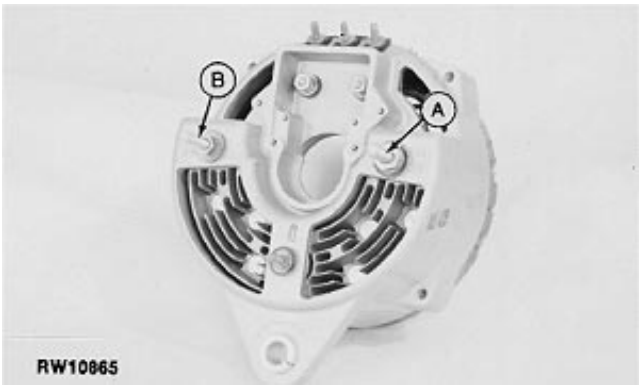
RW10864 –UN–17NOV89

Ohmmeter

RG,RG34710,2082 –19–09MAY02–9/22

18. Remove positive stud (A) and negative stud (B) nuts, and leads to stator taps. Remove diode heat sink assembly from rear housing.

    A—Positive Stud
    B—Negative Stud



RW10865 –UN–17NOV89

Remove Diode Heat Sink Assembly

Continued on next page

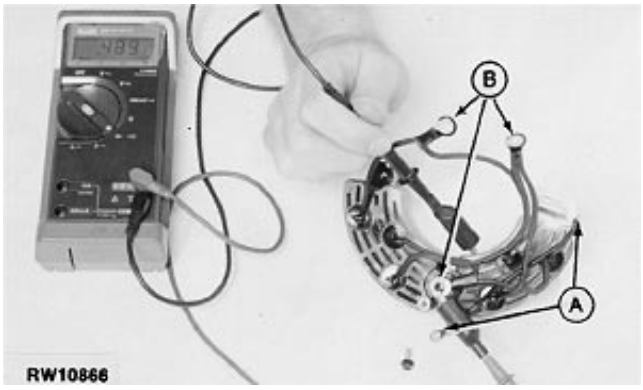
RG,RG34710,2082 –19–09MAY02–10/22

19. Disconnect capacitor lead (A) from heat sink.

NOTE: Make sure that heat sink halves are insulated from each other.

20. Connect ohmmeter to each lead (B) and heat sink. Reverse leads and test for continuity between same points. Perform this check on both (+) and (—) heat sink assemblies. Good diodes will have continuity in only one direction. Replace assembly if there is no continuity in either direction or continuity in both directions.

A—Capacitor Lead
B—Leads



RW10866 –UN–17NOV89

Capacitor Leads

15
25
9

RG,RG34710,2082 –19–09MAY02–11/22

21. Set multimeter for highest resistance (ohms) scale of diode test position to test capacitor.

22. Connect meter test leads to condenser lead (A) and body (B) as shown. Charge condenser for 15 seconds before disconnecting one test lead.

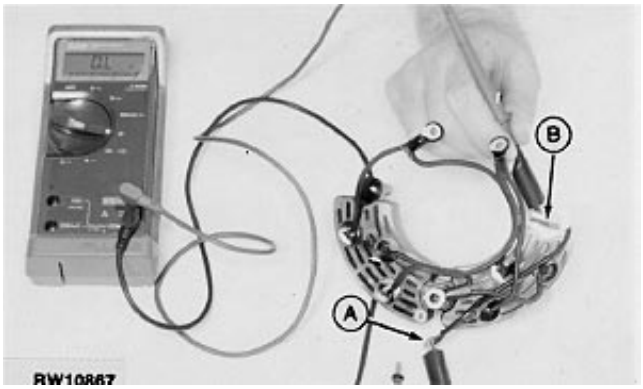
    If the multimeter indicates continuity through the condenser, it is leaking current and needs to be replaced.

23. Reset multimeter for a low voltage scale.

24. Observe voltmeter needle (digital read-out) for a voltage increase as you reconnect the test lead.

    If there was no voltage reading, the condenser was not charged and needs to be replaced.

25. Repeat the last four steps several times to verify condenser performance.



RW10867 –UN–17NOV89

Condenser Lead and Body

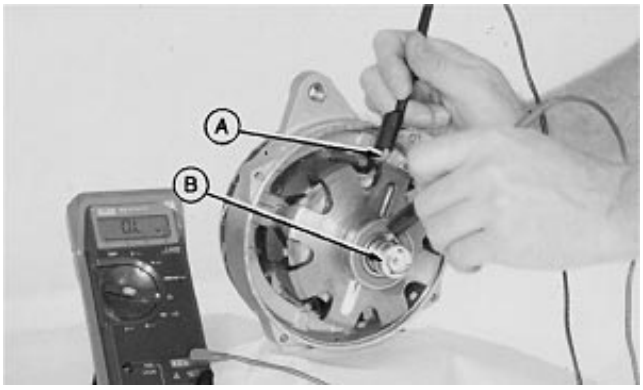
A—Condenser Lead
B—Condenser Body

Continued on next page

RG,RG34710,2082 –19–09MAY02–12/22

26. Use an ohmmeter to test rotor for continuity.
27. Attach ohmmeter to rotor frame (A) and each slip ring (B).
28. Replace rotor if test shows continuity.

A—Rotor Frame
B—Slip Ring



Rotor Frame and Slip Ring

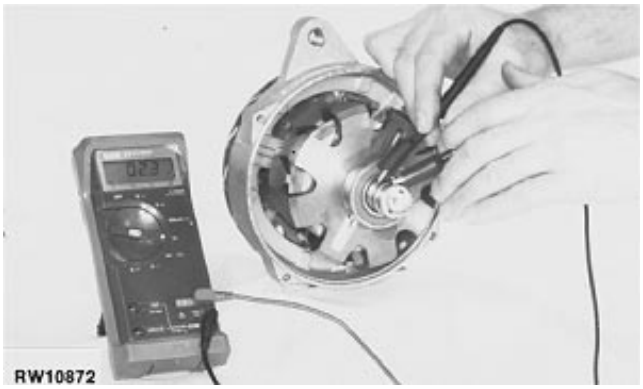
RG,RG34710,2082 –19–09MAY02–13/22

29. Use ohmmeter to test for continuity from one slip ring to the other or at soldered connections at end of rotor.

    If test does not show continuity, replace rotor.

30. Measure rotor winding resistance.

    Rotor winding resistance should be 2.0—3.0 ohms for 130-amp circuits and 4.7—5.8 ohms for 84-amp circuits.



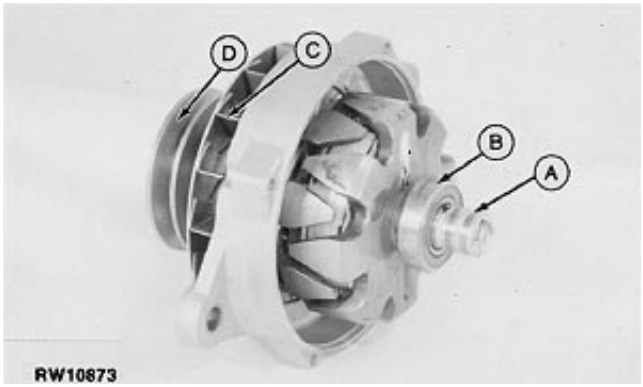
Ohmmeter

Continued on next page

RG,RG34710,2082 –19–09MAY02–14/22

31. Inspect rotor slip rings (A) for excessive wear or roughness. Use fine crocus cloth to remove minor roughness.
32. Check front and rear bearings (B) for roughness.
33. Check fan (C) for loose or bent blades.
34. Check pulley (D) for excessive wear.

    If bearings, slip rings or pulley are rough or worn or fan is damaged, continue with disassembly.



RW10873 –UN–16NOV89

Inspect Components

A—Rotor Slip Ring
B—Rear Bearing
C—Fan
D—Pulley

RG,RG34710,2082 –19–09MAY02–15/22

35. Unsolder rotor leads from slip ring terminals.

IMPORTANT: Do not overheat slip ring terminals.

36. Carefully unwind ends of rotor coil leads from slip ring terminals.

N85162O1 –UN–22SEP88

Unsolder Rotor Leads

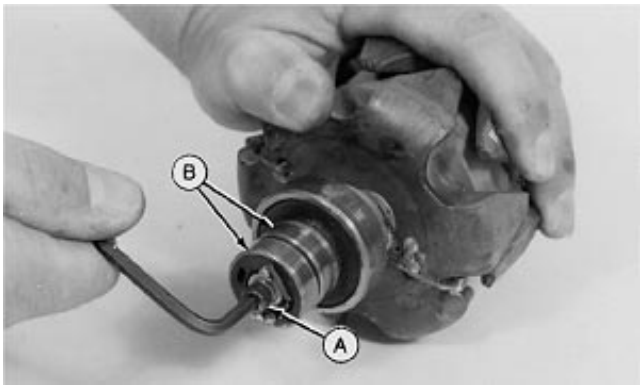
Continued on next page

RG,RG34710,2082 –19–09MAY02–16/22

37. Remove hex countersunk head screw (A) from end of shaft.

38. Thread a 1/4 x 1 in. cap screw into slip ring hub. This will back slip ring assembly (B) off shaft.

A—Hex Countersunk Head Screw
B—Slip Ring Assembly



N85162P1 –UN–22SEP88

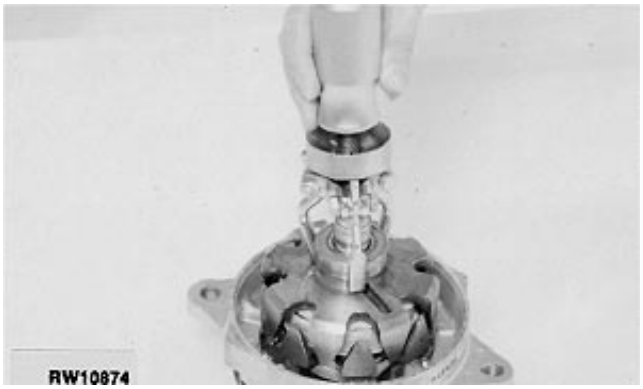
Shaft

15
25
12

RG,RG34710,2082 –19–09MAY02–17/22

IMPORTANT: Do not press on porcelain center of slip rings.

39. Use three-jaw puller and slide hammer to remove rear bearing from rotor.



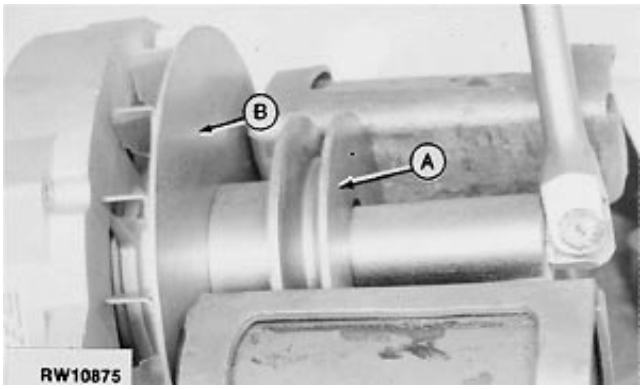
RW10874 –UN–16NOV89

RG,RG34710,2082 –19–09MAY02–18/22

40. Place pulley in vise using soft jaws to protect pulley. Remove pulley nut and lock washer.

41. Remove pulley (A) and fan (B).

A—Pulley
B—Fan



RW10875 –UN–16NOV89

Remove Pulley and Fan

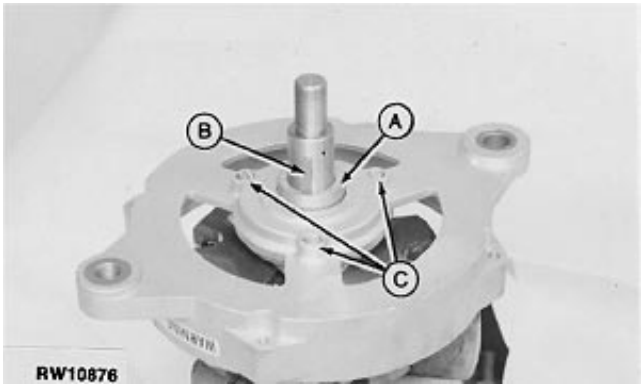
Continued on next page

RG,RG34710,2082 –19–09MAY02–19/22

42. Remove spacer (A) and woodruff key (B).

43. Remove three bearing retainer screws (C).

A—Spacer
B—Woodruff Key
C—Retainer Screws



RW10876 –UN–16NOV89

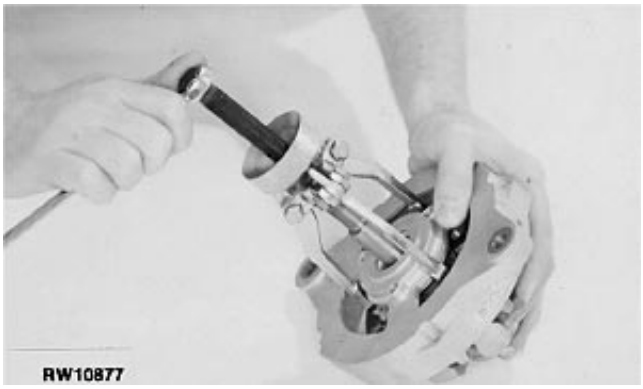
Remove Spacer and Woodruff Key

15
25
13

RG,RG34710,2082 –19–09MAY02–20/22

IMPORTANT: To prevent damage to front housing DO NOT support housing at outer circumference when removing rotor and front bearing.

44. Using three-jaw puller, push rotor and front bearing from front housing.



RW10877 –UN–16NOV89

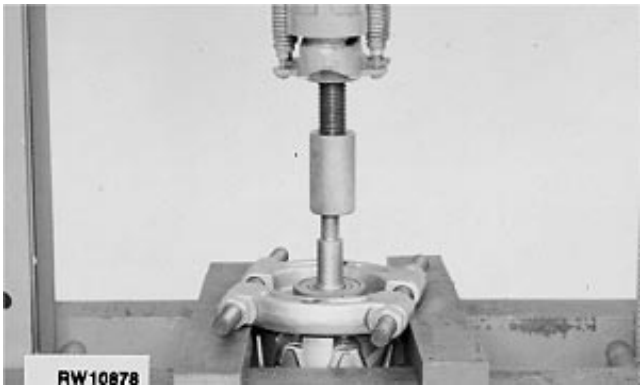
Three-Jaw Puller

Continued on next page

RG,RG34710,2082 –19–09MAY02–21/22

45. Remove front bearing only if bearing replacement is necessary. Use a knife-edge, bearing pulling attachment to remove front bearing from rotor shaft.

46. Inspect rotor shaft, body, and rear bearing for stripped threads on shaft, worn key slot, worn bearing surface, or scuffed pole finger. Replace rotor assembly if any of the above defects are found.



RW10878 –UN–16NOV89

Inspect Rotor Shaft, Body and Bearing

15
25
14

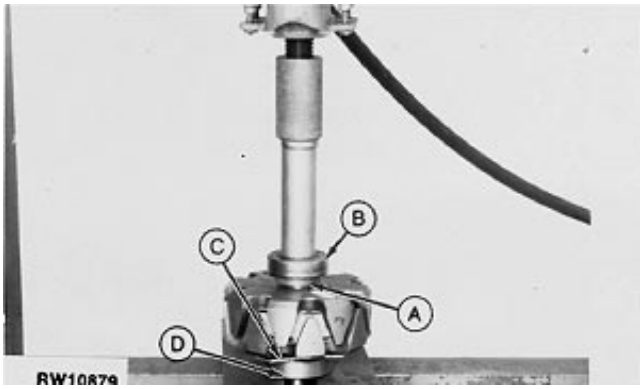
RG,RG34710,2082 –19–09MAY02–22/22

Assemble Motorola SA-Series Alternator

1. Install rear bearing spacer (A), sealing felt, rear bearing (B), front bearing retainer (C), sealing felt and front bearing (D).

2. Place assembly in small press. Using a 25.4 mm (1.0 in.) ID soft steel conduit, push assembly together until spacers and bearings are seated against rotor frame.

A—Rear Bearing Spacer
B—Rear Bearing
C—Front Bearing Retainer
D—Front Bearing



RW10879 –UN–16NOV89

Motorola SA Alternator

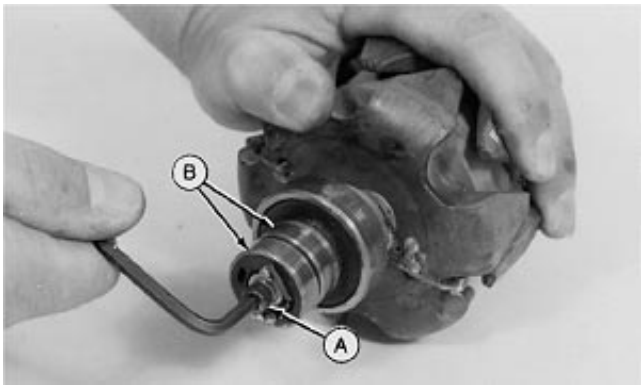
Continued on next page

RG,RG34710,2083 –19–09MAY02–1/13

3. Guide rotor windings through one passage in slip ring hub.
4. Hand press slip rings (B) on shaft while maintaining alignment of winding leads and passage.
5. Tighten hex countersunk head screw (A) to specifications.

Specification

Slip Ring Retainer Screw—
Torque ..... 5.1 N•m (45 lb-in.)



N85162P1 –UN–22SEP88

Slip Rings and Head Screw

A—Hex Countersunk Head Screw
B—Slip Rings

RG,RG34710,2083 –19–09MAY02–2/13

6. Install a fiber washer on the non-soldered terminal of slip rings. This is to prevent the inner slip ring from touching the outer slip ring, causing a short.
7. Wrap leads (A) around slip ring terminals and solder with rosin-core solder. Do not overheat.
8. Secure wires to end of rotor with a synthetic sealer.
9. Retest rotor assembly to ensure that a ground or short circuit did not develop during repair.

N85162Q1 –UN–22SEP88

Wrap Leads Around Terminals

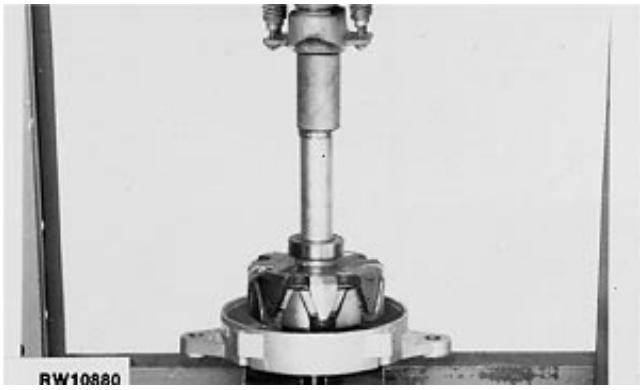
A—Leads

Continued on next page

RG,RG34710,2083 –19–09MAY02–3/13

IMPORTANT: Support front housing on bearing quill.

10. Press rotor with front bearing into front housing.



RW10880 –UN–16NOV89

Press Rotor Into Front Housing

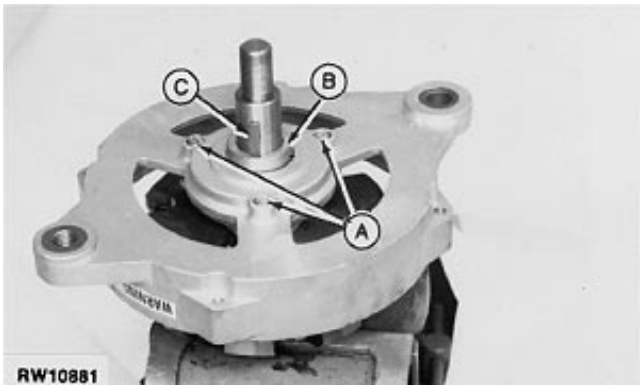
15
25
16

RG,RG34710,2083 –19–09MAY02–4/13

11. Apply LOCTITE® 242 Thread Lock and Sealer to front bearing screws (A) and reinstall.

12. Reinstall spacer (B) and woodruff key (C).

A—Front Bearing Screws (3 Used)
B—Spacer
C—Woodruff Key



RW10881 –UN–16NOV89

Reinstall Spacer and Woodruff Key

LOCTITE is a registered trademark of Loctite Corp.

Continued on next page

RG,RG34710,2083 –19–09MAY02–5/13

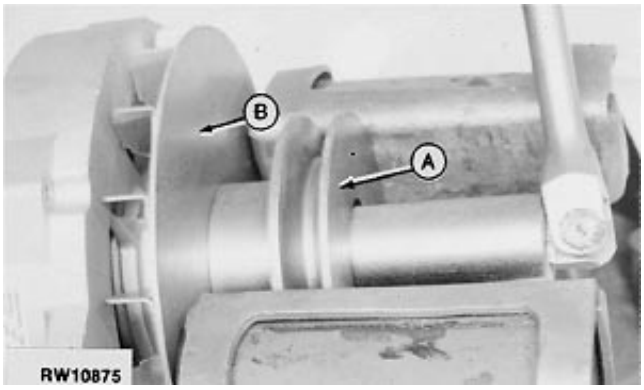
13. Install fan (B), pulley (A), lock washer and nut.

14. Tighten pulley nut to specifications.

Specification

Pulley Retaining Nut—Torque..... 68 N•m (50 lb-ft)

A—Pulley
B—Fan



RW10875 –UN–16NOV89

Install Fan and Pulley

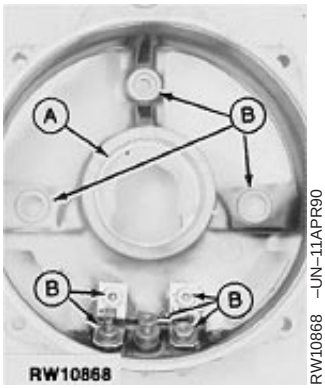
15
25
17

RG,RG34710,2083 –19–09MAY02–6/13

15. Inspect rear housing bearing bore (A) for scuffs or cracks. Replace as necessary.

16. Check and install all inside insulators (B).

A—Rear Housing Bearing Bore
B—Inside Insulators



RW10868 –UN–11APR90

Inspect Rear Housing

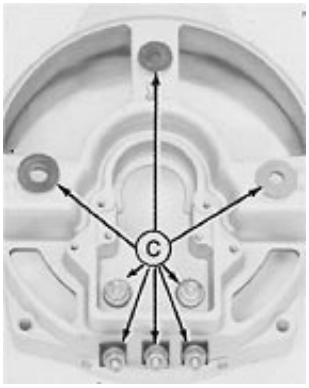
Continued on next page

RG,RG34710,2083 –19–09MAY02–7/13

17. Check and install outside insulators (C).

NOTE: Do not attempt to remove rear bearing, nylon retaining ring. Retaining ring does not normally need to be replaced. Replace only if cracked or gouged or if there is evidence of bearing spin.

C—Outside Insulators



Outside Insulator

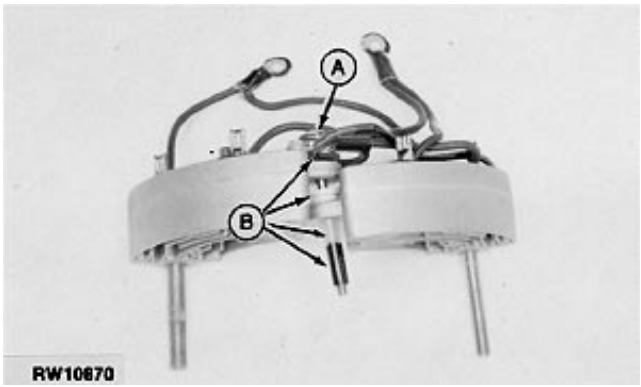
15
25
18

RG,RG34710,2083 –19–09MAY02–8/13

18. Install “R” terminal bolt (A) through stator lead and diode lead eyelets with three insulators (B).

19. Install diode heat sink into rear housing.

A—“R” Terminal Bolt
B—Insulators (3 Used)



Terminal Bolt and Insulators

Continued on next page

RG,RG34710,2083 –19–09MAY02–9/13

20. Install stator assembly into rear housing.

21. Install the “R” terminal stud (B).

22. Install leads on three stator terminals (A).

A—Stator Terminals (3 Used)
B—“R” Terminal Stud
C—Stator

Install Terminal Stud and Leads

RG,RG34710,2083 –19–09MAY02–10/13

23. Install rear housing assembly to front housing.

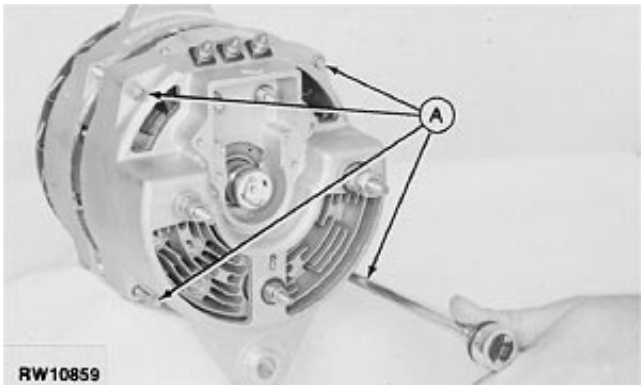
24. Apply LOCTITE® 242 Thread Lock and Sealer to through bolts (A) and install. Tighten evenly so rear rotor bearing is pressed into rear housing. Tighten until stator and housings are securely fastened together.

25. Tighten through bolts to specifications.

Specification

Housing Through Bolts—Torque..... 5.7—6.8 N•m (50—60 lb-in.)

NOTE: Lubricate rear retaining ring (in rear housing bearing bore) with liquid soap.



Through Bolts

A—Through Bolts (4 Used)

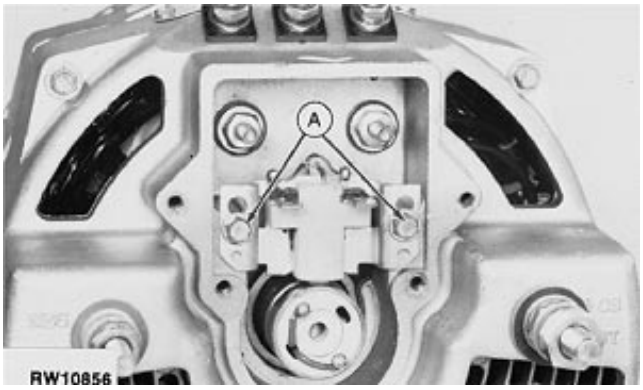
LOCTITE is a registered trademark of Loctite Corp.

Continued on next page

RG,RG34710,2083 –19–09MAY02–11/13

26. Install brush assembly. Install and tighten brush assembly retaining cap screws (A) securely.

A—Brush Assembly Retaining Cap Screws (2 Used)

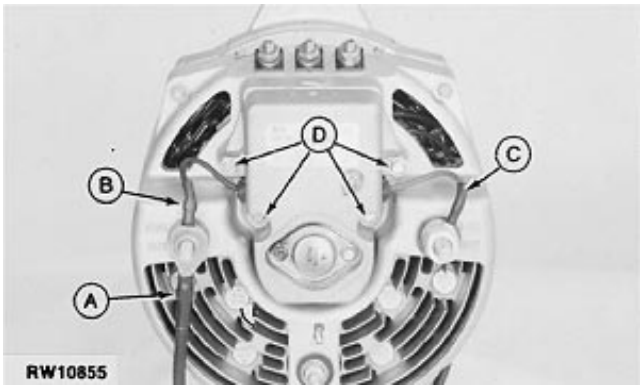


RW10856 –UN–17NOV89

Brush Assembly Retaining Cap Screws

RG,RG34710,2083 –19–09MAY02–12/13

27. Install gasket on voltage regulator.
28. Connect two regulator brush leads to brush assembly.
29. Install regulator and tighten retaining cap screws (D) securely.
30. Install alternator ground wire (A) and regulator ground lead (B). Install washer and tighten nut securely.
31. Install regulator positive lead (C) with washer and tighten nut securely.
32. Refer to your machine technical manual for installation of alternator and proper adjustment of V-belts.



RW10855 –UN–17NOV89

Install Gasket

A—Alternator Ground Wire
B—Regulator Ground Lead
C—Regulator Positive Lead
D—Retaining Cap Screws

RG,RG34710,2083 –19–09MAY02–13/13

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B68 –19–08MAY02–1/4

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUO1004,0000B68 –19–08MAY02–2/4

Alternator, Generator, Starter and Battery Bench Tester. JT01760

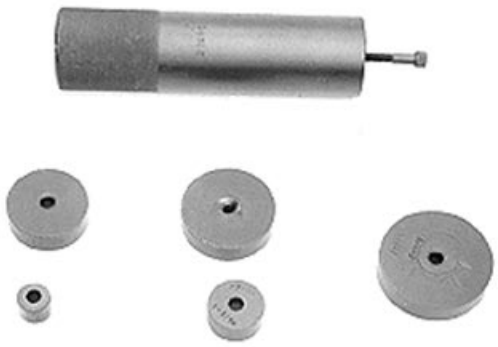
Test alternators and starters for voltage, resistance, or current flow.

Continued on next page

OUO1004,0000B68 –19–08MAY02–3/4

Bushing, Bearing and Seal Driver Set D01045AA

Install seal in front housing of alternator.



RG11162 –UN–21SEP00

D01045AA

OUO1004,0000B68 –19–08MAY02–4/4

Service Equipment and Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC). Some tools may be available from a local supplier.

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B69 –19–21SEP00–1/2

17-1/2 Ton Puller Set. D01047AA

Remove alternator pulley.

OUO1004,0000B69 –19–21SEP00–2/2

Motorola TA-Series Charging Circuit Repair Specifications

Item	Measurement	Specification
Brush	Minimum Exposed Length	6.4 mm (0.25 in.)
Alternator Pulley Retaining Nut	Torque	47—68 N•m (35—50 lb-ft)
Front-to-Rear Alternator Housing Cap Screws	Torque	2.8—3.4 N•m (20—30 lb-in.)
Brush Holder Retaining Screws	Torque	2.8—3.4 N•m (20—30 lb-in.)

OUO1004,0000B6B –19–21SEP00–1/1

Motorola TA-Series Charging Circuit Test Specifications

John Deere Part No.	Motorola Part No.	Volts	Rated Amps	Output Test[a] Amps (Hot)	Field Current[b] Amps	Winding Resistance[c] Ohms
AN114058	8TA2009E	12	30	28—30	0.55—1.50	11.0—12.5
AT22870	TA12NJD400	12	30	28—30	0.55—1.50	11.0—12.5
AT31669	8TA2009EB	12	30	28—30	0.55—1.50	11.0—12.5
AT36220	8TA2003D	12	22	18—20	0.55—1.50	11.0—12.5
AT41070	8TA2006D	12	22	18—20	0.55—1.50	11.0—1.25
AT45618	8TA2017D	12	22	18—20	0.55—1.50	11.0—12.5
AT56246	8TA3025CS	24	16	10—14	0.08—1.20	27.0—29.0
AT56247	8TA3025C	24	16	10—14	0.08—1.20	27.0—29.0
[a]Output test @ 3000—4000 RPM.						
[b]Field current @ 10V for 12V system and 20V for 24V systems; @ 20—27°C (70—80°F).						
[c]Winding resistance @ 20—27°C (70—80°F).						

Item	Specification
Rotor Current Draw @ 20—27°C (70—80°F)	0.55—1.56 amps

RG,RG34710,2085 –19–08SEP00–1/1

Remove Alternator for Repair

Refer to your machine technical manual for removal of alternator.

IMPORTANT: Never immerse alternator in cleaning solvent. Remove dirt and grease by scraping and using a stiff brush with solvent. Dry with compressed air.

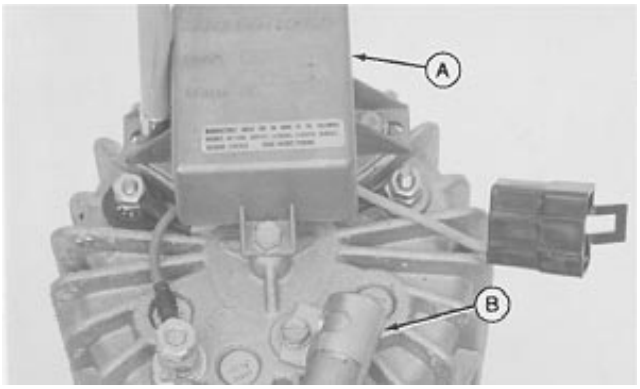
ONLY rosin core solder should be used for soldering operations. The use of acid core solder will result in rapid corrosion of the windings and eventual failure of the complete alternator unit.

RG,RG34710,2086 –19–15MAR97–1/1

Disassemble and Test Motorola TA-Series Alternator

1. Remove voltage regulator (A) and capacitor (B) from alternator.

A—Voltage Regulator
B—Capacitor



Remove Voltage Regulator and Capacitor

Continued on next page

RG,RG34710,2087 –19–15MAR97–1/20

2. Remove brush cover (A) and gasket.

A—Brush Cover and Gasket

T5916AG –UN–12APR90

Remove Brush Cover and Gasket

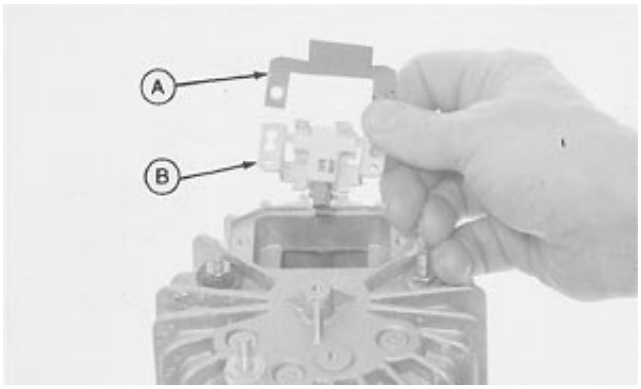
RG,RG34710,2087 –19–15MAR97–2/20

3. Remove isolator (A) and brush assembly (B). Inspect brushes. If either one is worn beyond specification, cracked or oil soaked, replace the brush assembly.

Specification

Brush—Minimum Exposed Length..... 6.4 mm (0.25 in.)

A—Isolator
B—Brush Assembly



T91364 –UN–14FEB90

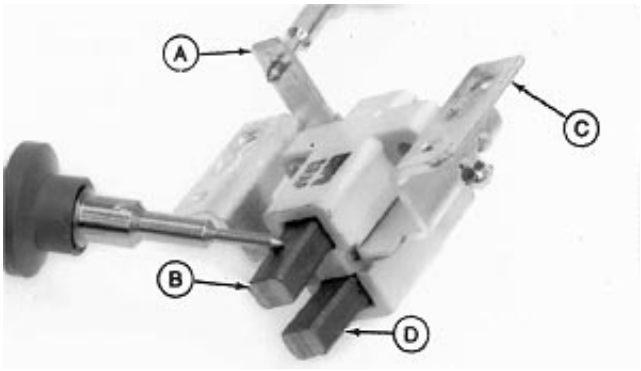
Remove Isolator and Brush Assembly

Continued on next page

RG,RG34710,2087 –19–15MAR97–3/20

4. Check for continuity between terminal (A) and brush (B) and bracket (C) and brush (D). If there is no continuity at either brush, replace the brush assembly.
5. Check for continuity between terminal (A) and bracket (C). If there is continuity, replace the brush assembly.
6. Check for continuity between terminal (A) and brush (D). If there is continuity, replace the brush assembly.

A—Terminal
B—Brush
C—Bracket
D—Brush



T87568 –UN–23FEB90

Check for Continuity

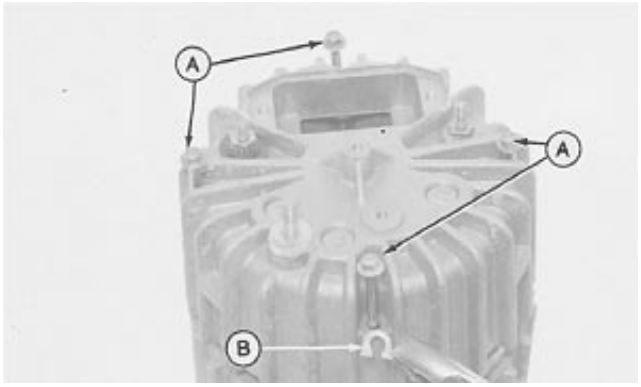
RG,RG34710,2087 –19–15MAR97–4/20

7. Remove cap screws (A) to separate the housings. Note horseshoe clip (B) at lower cap screw.

IMPORTANT: Inserting screwdriver blades farther than 1.6 mm (1/16 in.) may damage stator windings.

8. Carefully insert two screwdriver blades in opposite openings between the stator and front housing and separate the front housing from the rear.

A—Cap Screws (4 Used)
B—Horseshoe Clip



T91366 –UN–14FEB90

Separate Front Housing

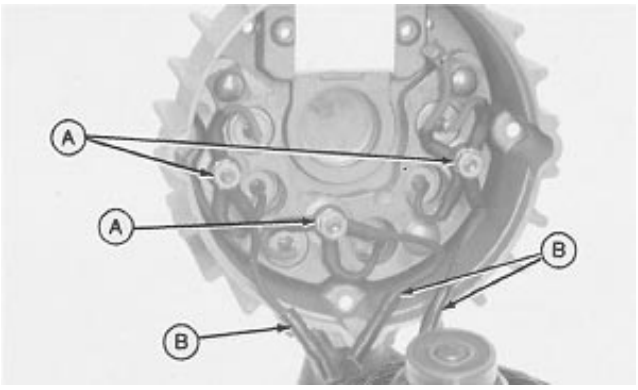
Continued on next page

RG,RG34710,2087 –19–15MAR97–5/20

9. Remove nuts and washers (A) to disconnect stator leads (B).

NOTE: Remove diode leads from stud terminal.

A—Nuts and Washers (3 Used)
B—Stator Leads



T91367 –UN–14FEB90

Disconnect Stator Leads

RG,RG34710,2087 –19–15MAR97–6/20

10. Use ohmmeter to check rotor windings by placing a probe on each slip ring. If there is no continuity, replace the rotor.

T91373 –UN–14FEB90

Check Rotor Windings

Continued on next page

RG,RG34710,2087 –19–15MAR97–7/20

11. Use ohmmeter to check for grounded rotor windings. If there is continuity, replace the rotor.

Check for Grounded Rotor Windings

RG,RG34710,2087 –19–15MAR97–8/20

12. Use ohmmeter to check the stator for an open winding. Check all the leads. If there is no continuity in any of the connections, there is an open circuit in the stator windings and the stator must be replaced.

Check Stator and Leads

Continued on next page

RG,RG34710,2087 –19–15MAR97–9/20

13. Use ohmmeter to check the stator for a grounded winding. Touch one probe to any of the leads and one to the ground. The meter must not register continuity. If it registers continuity, a stator winding is grounded and the stator must be replaced.

Check Stator

RG,RG34710,2087 –19–15MAR97–10/20

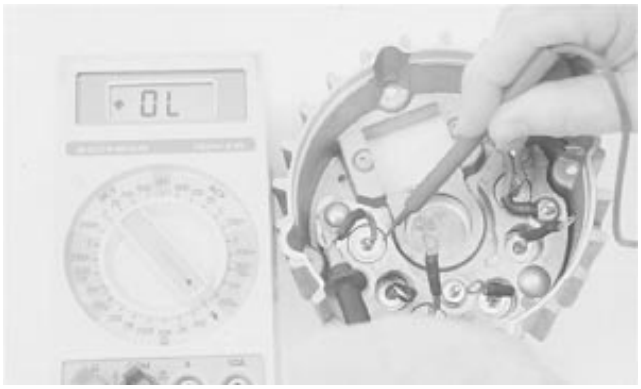
IMPORTANT: The diode test position must be used on meters with test position to get accurate results. Follow the manufacturer's instructions for your meter to test diodes.

14. Test positive and negative diodes in both directions using a volt-ohm-amp meter. Put one probe on a diode lead and the other probe on the diode plate to get a reading.

    A diode with a high reading in one direction and a low reading in the other direction is good. A diode with the same reading in both directions is defective and should be replaced.

    Test diode trio in both directions using a volt-ohm-amp meter. Put probes on each end of diode to get a reading.

    A diode trio with a high reading in one direction and a low reading in the other direction is good. A diode trio with the same reading in both directions is defective and should be replaced.



Test Diodes

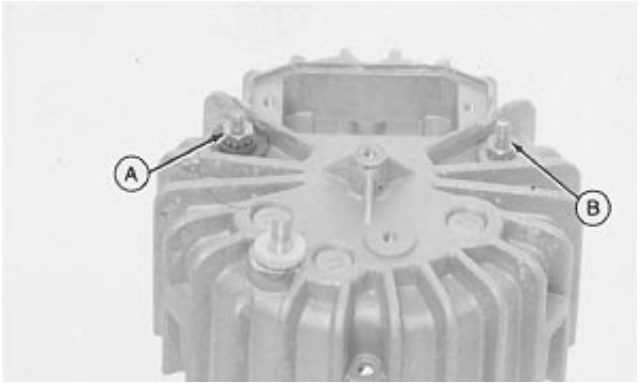
Test Diodes

Continued on next page

RG,RG34710,2087 –19–15MAR97–11/20

15. To separate the diode plate from the alternator half, remove the nut and insulator on the stator terminal (A) and the nut on the ground terminal (B).

A—Stator Terminal
B—Ground Terminal



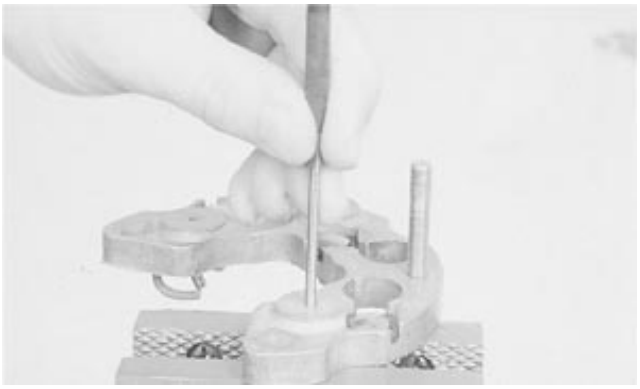
Stator and Ground Terminals

RG,RG34710,2087 –19–15MAR97–12/20

16. Remove diodes if defective. Use a standard punch.

IMPORTANT: Support underside of casting to prevent damage when removing diodes.

The rectifying diode in TA-Series alternators have their leads welded, not soldered, to the stems. Do not attempt to substitute diode and solder the lead to the diode stem.



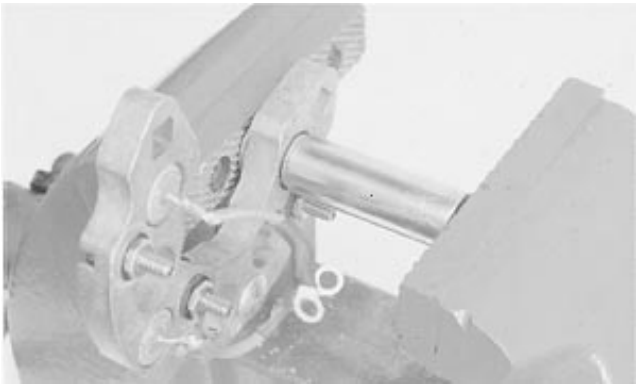
Remove Defective Diodes

Continued on next page

RG,RG34710,2087 –19–15MAR97–13/20

17. To replace the diodes, use a piece of pipe to press diodes into diode plate.

IMPORTANT: Before installing diode plate, make certain that it is properly insulated from housing. (See ASSEMBLE MOTOROLA TA-SERIES ALTERNATOR in this group.)

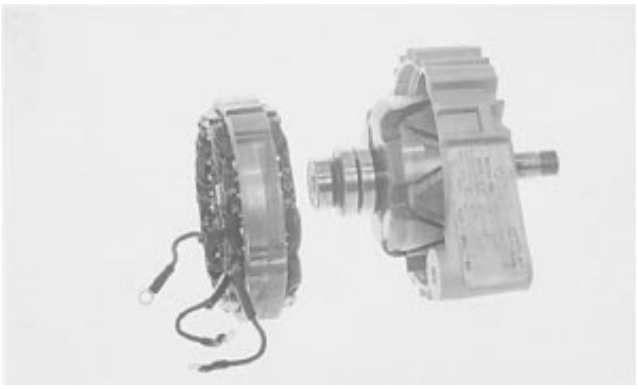


T91380 –UN–14FEB90

Replacing Diodes

RG,RG34710,2087 –19–15MAR97–14/20

18. Remove the front housing from the stator.



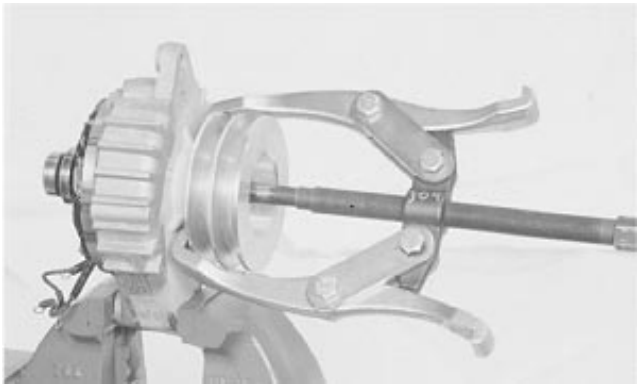
T91381 –UN–14FEB90

Remove Front Housing

Continued on next page

RG,RG34710,2087 –19–15MAR97–15/20

19. Remove nut and lock washer. Remove the pulley with a gear puller from D01047AA 17-1/2 Ton Puller Set.



Remove Pulley

RG,RG34710,2087 –19–15MAR97–16/20

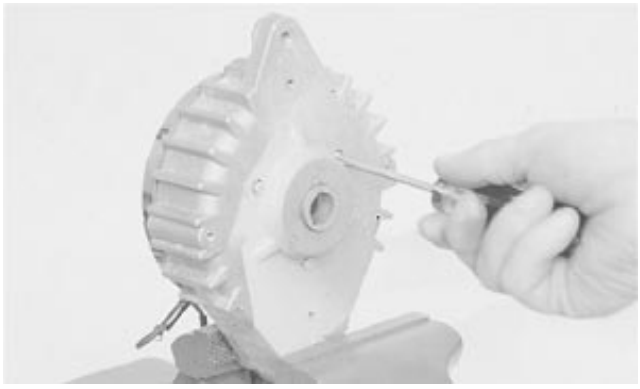
20. To remove rotor, remove the key from the shaft and tap on the shaft with a plastic hammer.

Remove Rotor

Continued on next page

RG,RG34710,2087 –19–15MAR97–17/20

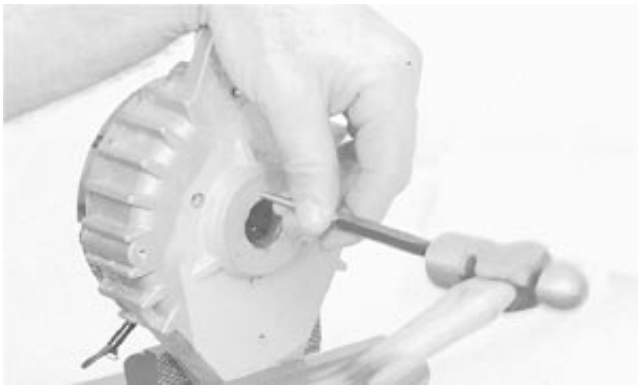
21. Remove three screws and lock washers to remove bearing retainer.



Remove Bearing Retainer

RG,RG34710,2087 –19–15MAR97–18/20

22. Remove the front seal and bearing using a 3/32 in. punch.

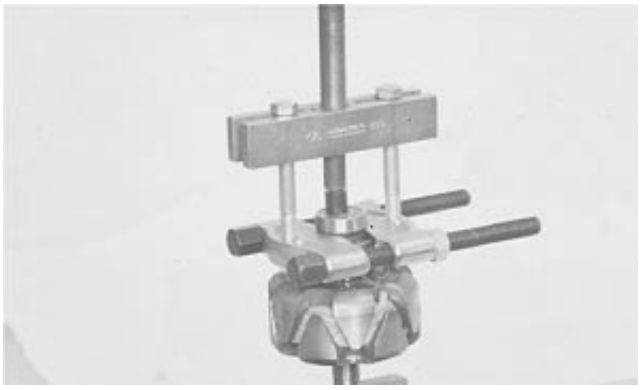


Remove Front Seal and Bearing

Continued on next page

RG,RG34710,2087 –19–15MAR97–19/20

23. Remove the rear bearing if bearing replacement is necessary.



T91386 –UN–14FEB90

Remove Rear Bearing if Necessary

RG,RG34710,2087 –19–15MAR97–20/20

Assemble Motorola TA-Series Alternator

1. Install seal open face to driver from the D01045AA Bushing, Bearing and Seal Driver Set. Install seal in housing bore.

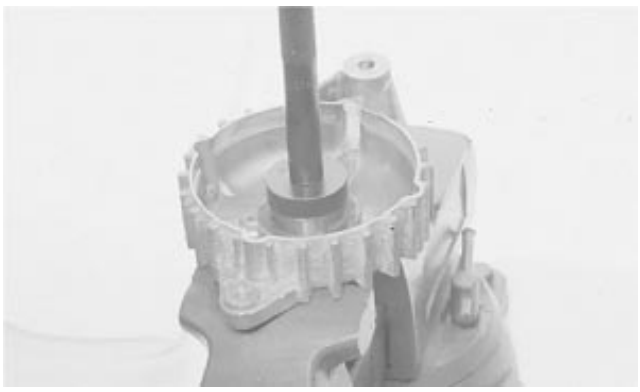
T91387 –UN–14FEB90

Install Seal in Housing Bore

Continued on next page

RG,RG34710,2088 –19–15MAR97–1/15

2. Install bearing using a driver that contacts the outer race.



Install Bearing

RG,RG34710,2088 –19–15MAR97–2/15

3. Install bearing retainer using three screws and washers.

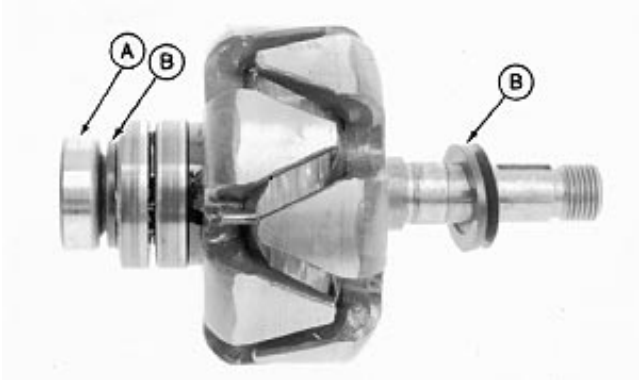
Install Bearing Retainer

Continued on next page

RG,RG34710,2088 –19–15MAR97–3/15

4. Install seals (B) and bearing (A).

A—Bearing
B—Seals



T5916AI –UN–12APR90

Install Seals and Bearing

RG,RG34710,2088 –19–15MAR97–4/15

5. Install rotor to housing. Install the spacer and shaft key. Install the pulley, lock washer and hex nut. Tighten hex nut to specifications.

Specification	
Alternator Pulley Retaining Nut—Torque	47—68 N•m (35—50 lb-ft)

IMPORTANT: Clamp pulley in a soft-jawed vise or use an old oversize belt to prevent damage to pulley.

T91390 –UN–14FEB90

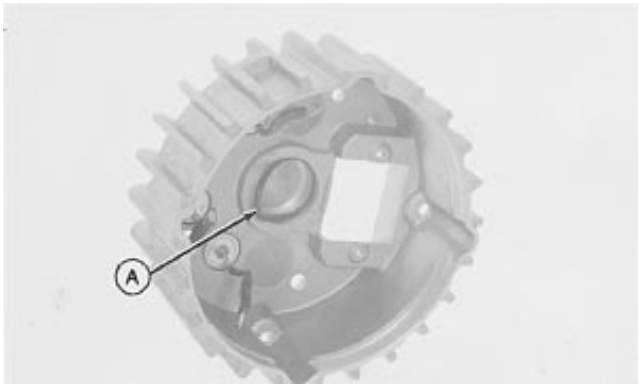
Install Rotor to Housing

Continued on next page

RG,RG34710,2088 –19–15MAR97–5/15

6. Install O-ring (A). Lubricate the exposed area of the O-ring with hydraulic brake fluid only. Do not use oil.

A—O-Ring



T91391 –UN–14FEB90

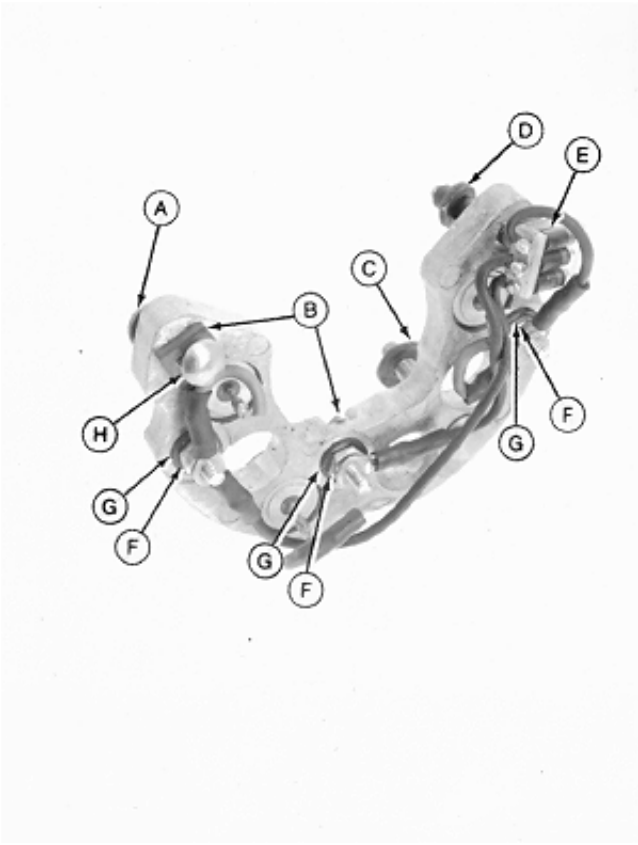
Install O-ring

15
30
17

RG,RG34710,2088 –19–15MAR97–6/15

7. Install diode plate mounting terminals, diode trio, and insulators (A—H) on diode plate.

A—Insulator
B—Insulator, Square (2 Used)
C—Insulator
D—Insulator
E—Diode Trio
F—Nut (3 Used)
G—Insulator (3 Used)
H—Bolt



T5919AD –UN–16APR90

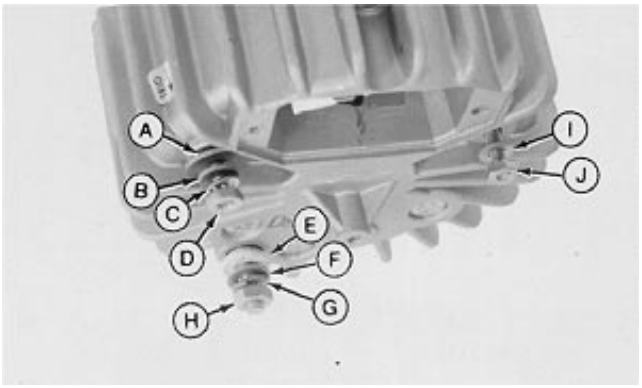
Install Diode Plate Mounting Terminals

Continued on next page

RG,RG34710,2088 –19–15MAR97–7/15

8. Install diode plate into rear housing. Install insulators, washers, and nuts (A—J).

A—Insulator Sleeve
B—Insulator
C—Washer
D—Nut
E—Insulator
F—Flat Washer
G—Lock Washer
H—Nut
I—Insulator
J—Nut

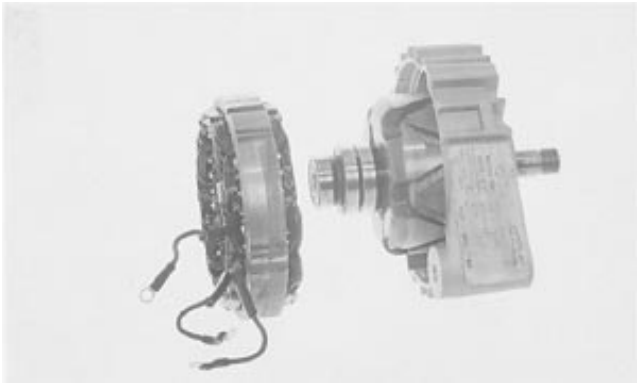


T6106AG –UN–02APR90

Install Diode Plate

RG,RG34710,2088 –19–15MAR97–8/15

9. Install stator into front housing. Install gasket.



T91381 –UN–14FEB90

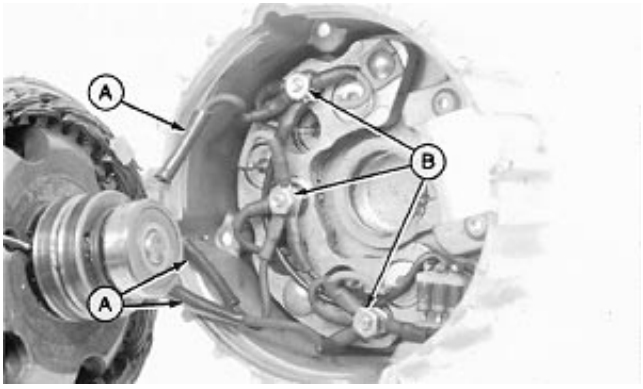
Install Stator and Gasket

Continued on next page

RG,RG34710,2088 –19–15MAR97–9/15

10. Connect each diode lead to the terminal (B) adjacent to it. Also connect stator leads (A) leads to terminals (B). Fasten with nuts and lock washers.

A—Stator Leads
B—Terminals

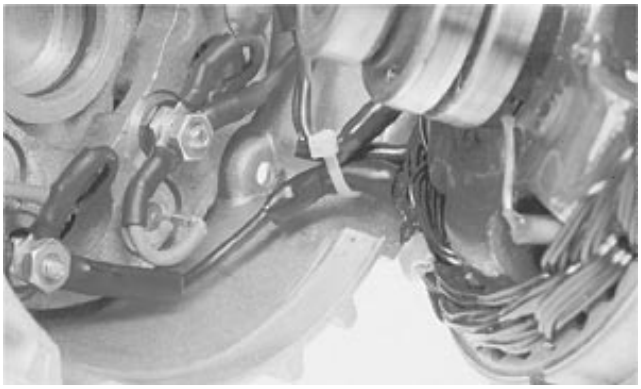


T5916AJ –UN–12APR90

Connect Leads

RG,RG34710,2088 –19–15MAR97–10/15

11. After stator leads are fastened to diode terminals, fasten the stator leads together using a tie band along the rear housing shell. Place stator leads as far as possible from rotor.



T92062 –UN–12FEB90

Attach Leads

Continued on next page

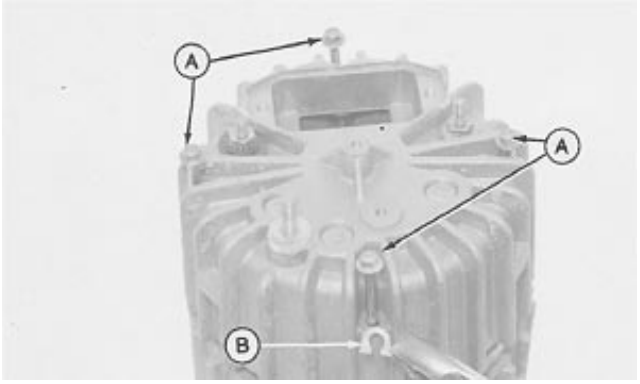
RG,RG34710,2088 –19–15MAR97–11/15

12. Install rear housing and stator into the front housing. Make sure grooves in stator line up with cap screw holes. Install four screws (A) and tighten to specifications. Horseshoe clip (B) must be installed on lower screw.

Specification

Front-to-Rear Alternator Housing Cap Screws—Torque ..... 2.8—3.4 N•m (20—30 lb-in.)

After assembly, rotate the alternator pulley. The pulley must rotate without any rough spots. Rough spots could be caused by the stator leads rubbing the rotor or a rough bearing. If rough spots are felt, disassemble rear housing and correct the problem.



T91366 –UN–14FEB90

Screws and Horseshoe Clip

A—Cap Screws (4 Used)
B—Horseshoe Clip

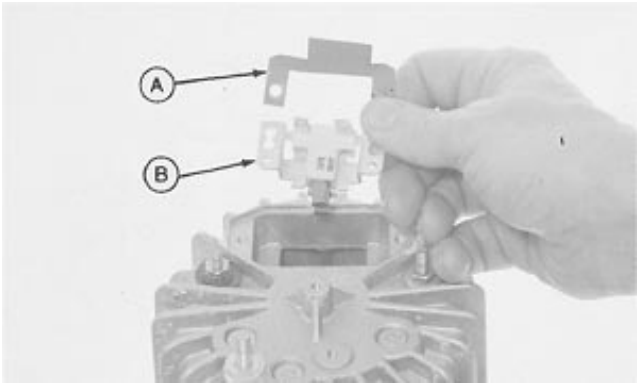
RG,RG34710,2088 –19–15MAR97–12/15

13. Install the brush assembly (B). Isolator (A) must be installed with tab over the brush leads to prevent brush leads from touching housing. Tighten brush holder retaining cap screws to specifications.

Specification

Brush Holder Retaining Screws—Torque ..... 2.8—3.4 N•m (20—30 lb-in.)

A—Isolator
B—Brush Assembly



T91364 –UN–14FEB90

Install Brush Assembly and Isolator

Continued on next page

RG,RG34710,2088 –19–15MAR97–13/15

14. Install brush holder cover (A) and dust shield.

A—Brush Holder Cover and Dust Shield

T5916AG –UN–12APR90

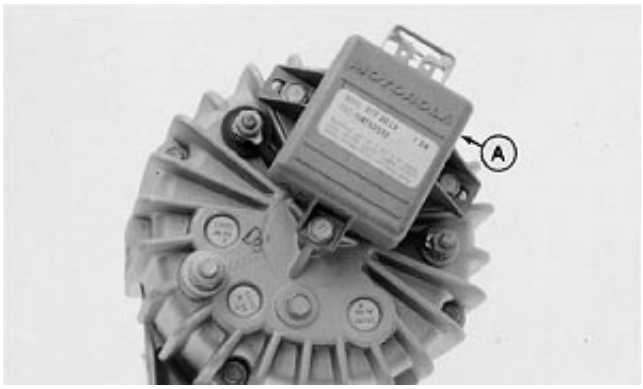
Brush Holder Cover and Shield

RG,RG34710,2088 –19–15MAR97–14/15

15. Install voltage regulator (A) and wiring leads.

16. Refer to your machine technical manual for installation of alternator.

A—Voltage Regulator



T6106AF –UN–02APR90

Voltage Regulator

RG,RG34710,2088 –19–15MAR97–15/15

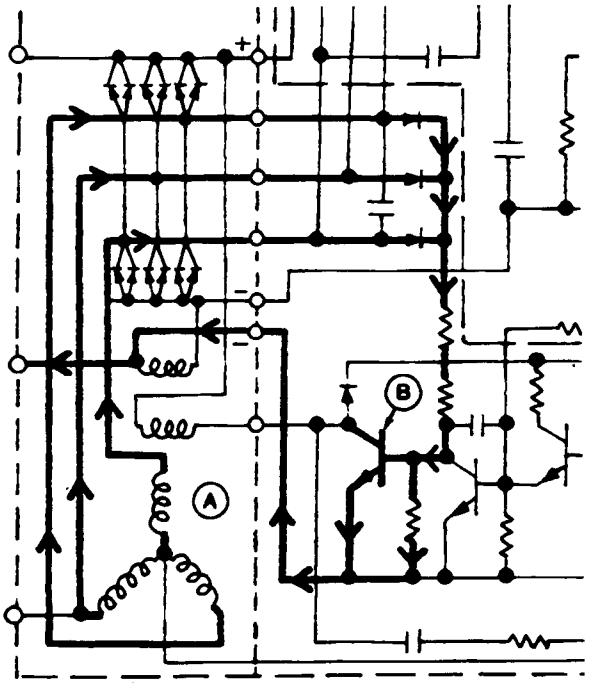
Section 20
Niehoff Alternators

Contents

Starting the Niehoff Alternator

As the engine is cranking to start, the alternator rotor will turn. The residual magnetism in the rotor and stationary forging creates a magnetic field. The turning rotor causes the magnetic field to alternately increase and decrease in strength. This induces current into the stator (A). This current is sufficient to turn on the power transistor (B). The alternator and regulator are now operating.

A—Stator
B—Power Transistor



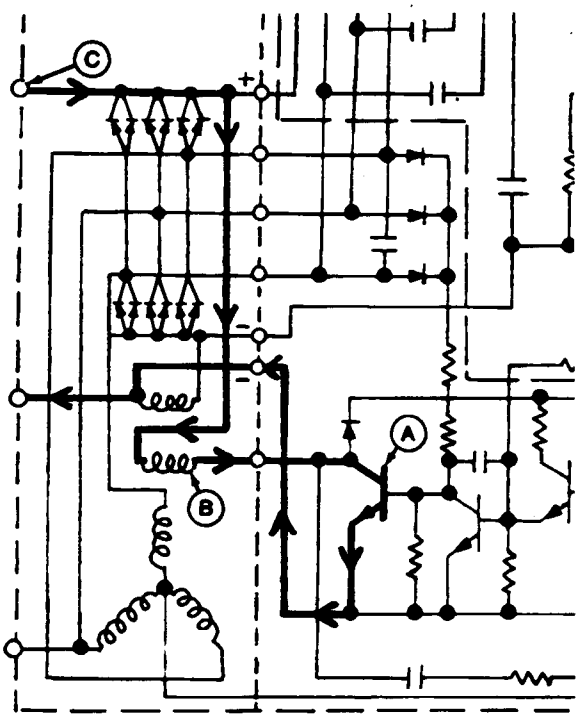
Starting Niehoff Alternator

RG,RG34710,2089 –19–15MAR97–1/1

Niehoff Alternator Operation

With the power transistor (A) on, field current is permitted to flow through the alternator field winding (B) from the battery (C). The field coil current will produce a magnetic field.

A—Power Transistor
B—Alternator Field Winding
C—Battery



Niehoff Alternator Operation

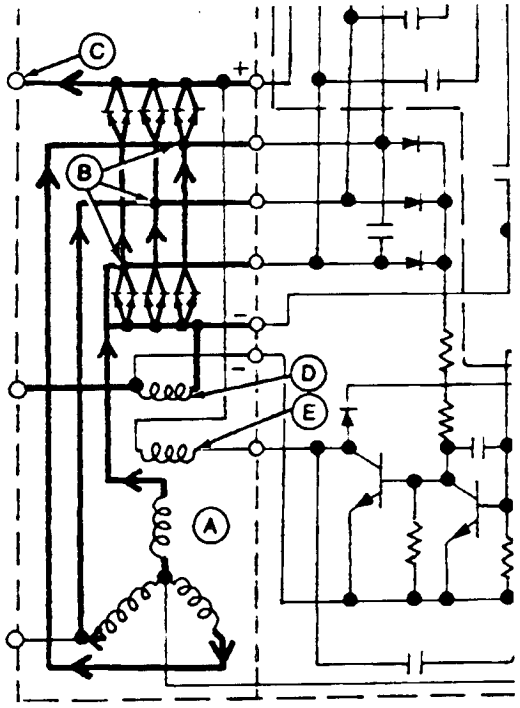
Continued on next page

RG,RG34710,2090 –19–15MAR97–1/3

This magnetic field flows through a small air gap to the rotor and to the stator windings. As the rotor turns, the magnetic field is alternately increased and decreased in strength. This induces an alternating three-phase voltage and current in the stator coil windings (A). The alternating current output from the stator is applied to a three-phase full wave bridge rectifier (B), which provides direct current to the battery (C).

The compound winding produces a magnetic field which adds to the magnetic field created by the field coil. This helps the alternator produce output at the high end of the output range.

A—Stator Coil Windings
B—Bridge Rectifier
C—Battery
D—Rotor Winding
E—Field Winding



RW5114 –UN–06APR89

Magnetic Field

Continued on next page

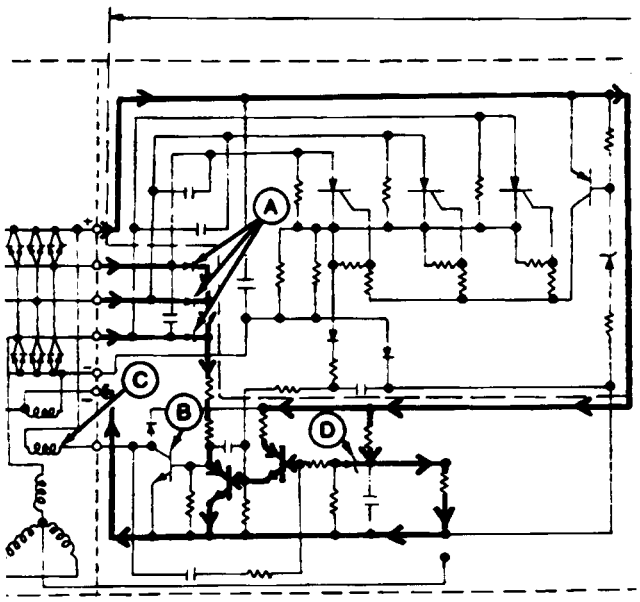
RG,RG34710,2090 –19–15MAR97–2/3

The voltage regulator senses the voltage of the charging system through the diode trio (A). If the alternator loading demand is high, the power transistor (B) becomes conductive for longer periods of time and supplies a greater amount of current to the field winding (C). An increase in current flow through the field winding causes an increase in alternator output voltage.

As the charging system builds up to the predetermined setting of the regulator, the Zener diode (D) in the regulator causes the power transistor (B) to turn off. With the power transistor (B) turned off, little or no current is applied to the field winding, thereby decreasing the alternator output voltage.

This on/off field switching action is repeated as often as necessary so that the average voltage output of the alternator is maintained at the regulator setting.

A—Diode Trio
B—Power Transistor
C—Field Winding
D—Zener Diode



RW5115 –UN–06APR89

Voltage Regulator

20
05
3

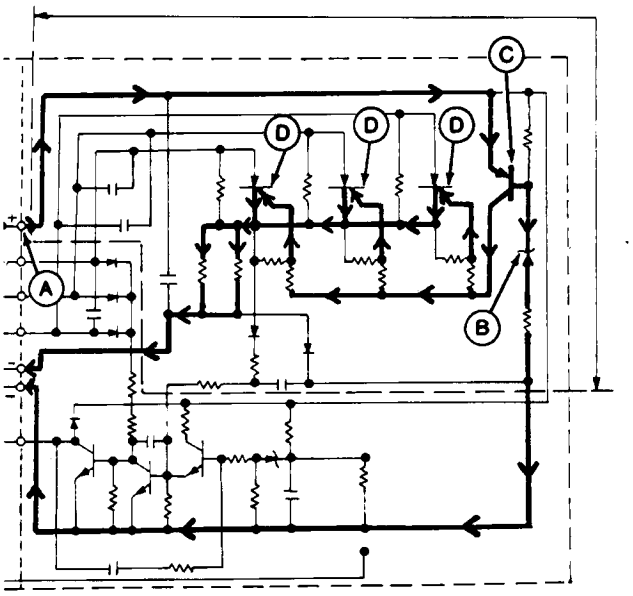
RG,RG34710,2090 –19–15MAR97–3/3

Niehoff Alternator Load Dump Circuit

The load dump circuit protects the alternator and the vehicle's electrical system when the battery connection is broken.

When the battery connection is broken, a high voltage appears at the alternator output (A). This high voltage causes the Zener diode (B) and the transistor (C) to conduct. This will turn on three SCR's (D)

A—Alternator Output
B—Zener Diode
C—Transistor
D—SCR's (3 Used)



RW5164 –UN–24MAY89

Load Dump Circuit

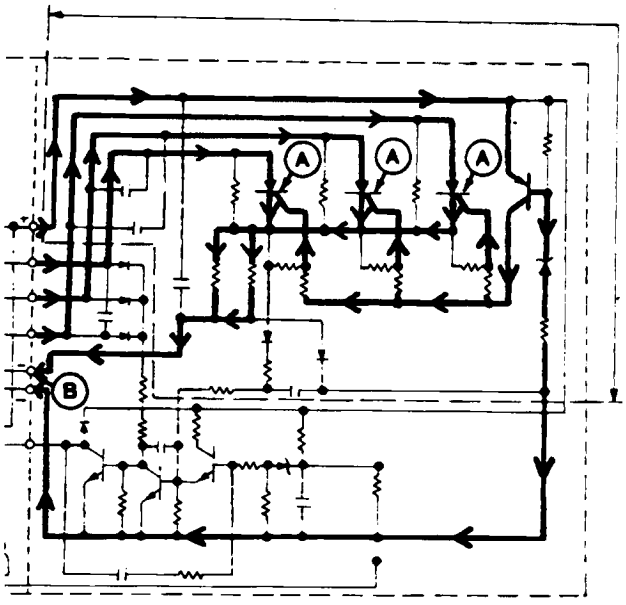
RG,RG34710,2091 –19–15MAR97–1/2

All the alternator output will flow through the three SCR's (A) to ground (B).

After a short time, the high voltage is gone and the regulator will take control of the alternator. The alternator output will remain at a level necessary to operate the vehicle's electrical system.

Repeated operation of the load dump circuit will result in regulator failure.

A—SCR's (3 Used)
B—Ground



RW5165 –UN–04MAY89

SCR to Ground

RG,RG34710,2091 –19–15MAR97–2/2

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B6C –19–08MAY02–1/6

Stator Support JDG255

Support shell while pressing out stator.

RW10306 –UN–10NOV89

JDG255

OUO1004,0000B6C –19–08MAY02–2/6

Blind Hole Puller Set D01061AA

Remove bearings from front housing assembly.

RG11161 –UN–21SEP00

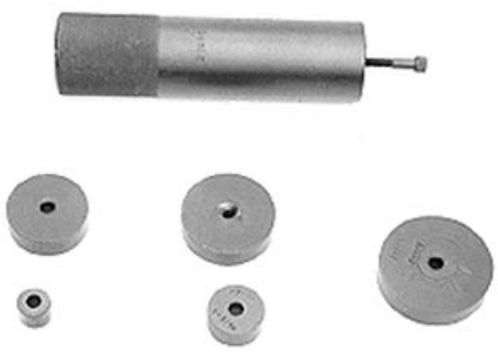
D01061AA

Continued on next page

OUO1004,0000B6C –19–08MAY02–3/6

Bushing, Bearing and Seal Driver Set D01045AA

Install bearings in front housing assembly.



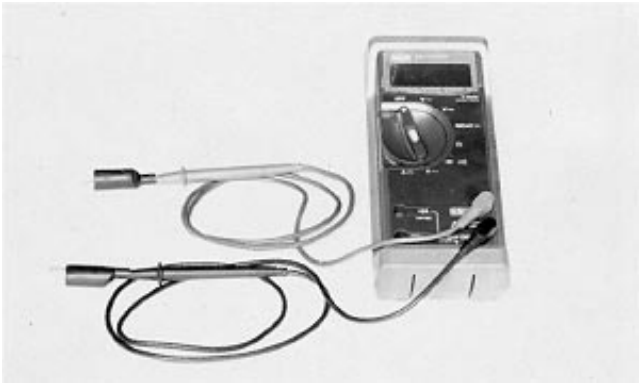
RG11162 –UN–21SEP00

D01045AA

OUO1004,0000B6C –19–08MAY02–4/6

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.



RW11274 –UN–12DEC88

JT05791

OUO1004,0000B6C –19–08MAY02–5/6

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000B6C –19–08MAY02–6/6

Other Material

Number	Name	Use
TY16285 (U.S.) CXTY24311 (Canadian) 222 (LOCTITE®)	Thread Lock and Sealer (Low Strength)	Apply to all cap screws and nuts when assembling alternator.
	High Temperature, Silicone Base Grease	Fill front and rear grease reservoir in alternator housing.
	Silicone Rubber Compound	Apply to all internal wiring lead cap screws.

LOCTITE is a registered trademark of Loctite Corp.

OUO1004,0000B6E –19–21SEP00–1/1

20
10
3

Niehoff 12-Volt Charging Circuit Repair Specifications

Item	Measurement	Specification
Fan Pulley Lock Nut	Torque	95 N•m (70 lb-ft)
Front Housing-to-Stator Shell Nuts	Torque	3.4 N•m (30 lb-in.)
Rotor Nut	Torque	68 N•m (50 lb-ft)
Regulator Field Lead-to-Standoff Screw and Y-Lead-to-Load Dump Screw	Torque	0.9—1.1 N•m (8—10 lb-in.)
Output and Relay Leads-to-Standoff Screw	Torque	2.3 N•m (20 lb-in.)
Ground Lead-to-Load Dump Screw	Torque	1.1—1.7 N•m (10—15 lb-in.)
Flanged Nuts	Torque	5.1 N•m (45 lb-in.)

OUO1004,0000B6F –19–21SEP00–1/1

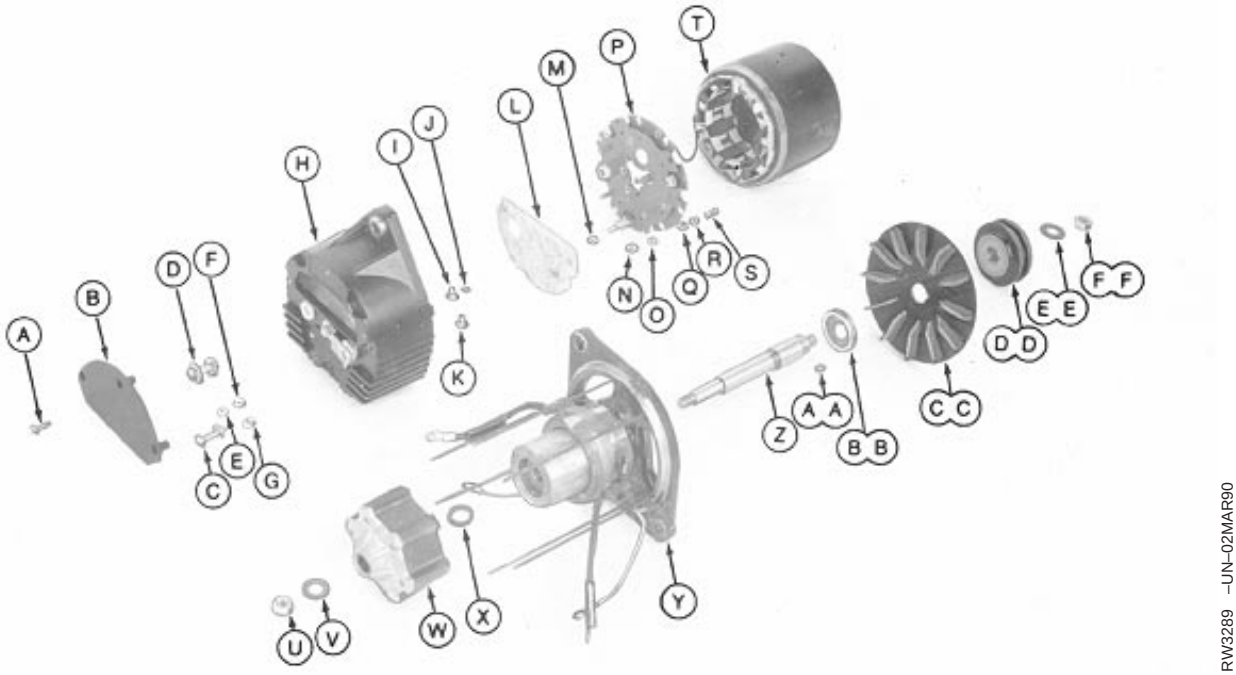
Niehoff 12-Volt Charging Circuit Test Specifications

John Deere Alternator Part No.	Niehoff Alternator Model No.	Ground	Voltage	Rated Output (Amps)	Winding Resistance @ 21—27°C (70—80°F) (Ohms)
AR94100	N1114-1	N	12	110	2.9—3.1

RG,RG34710,2094 –19–07JUL05–1/1

Disassemble Niehoff 12-Volt, 110-Amp Alternator

20
10
4



Niehoff 12-Volt, 110-Amp Alternator

A—Screw (3 Used)
B—Dust Cover
C—Ground Bolt with Washer
D—Battery Stud with Washers
E—Lock Nut
F—Insulator
G—Nut (6 Used)
H—Rear Housing
I—Screw (4 Used)
J—Washer (4 Used)
K—Screw (7 Used)
L—Regulator Assembly
M—Insulator
N—Nut (6 Used)
O—Insulator (6 Used)
P—Rectifier Assembly
Q—Insulator (6 Used)
R—Nut (6 Used)
S—Spacer (6 Used)
T—Stator Assembly
U—Lock Nut
V—Washer
W—Rotor
X—Washer
Y—Front Housing Assembly
Z—Shaft
AA—Woodruff Key
BB—Bearing Cover
CC—Fan
DD—Pulley
EE—Washer
FF—Nut

Refer to your machine technical manual for removal of alternator.

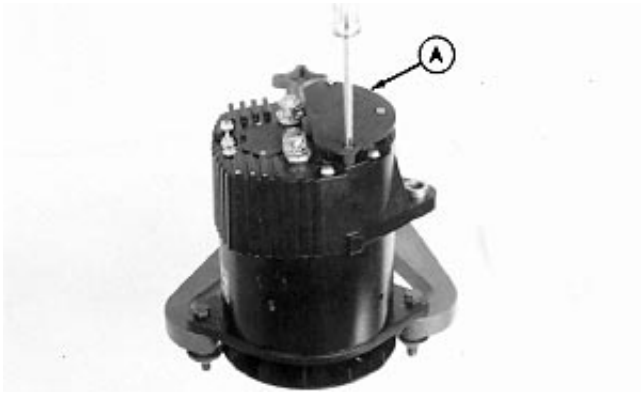
Continued on next page

RG,RG34710,2096 –19–15MAR97–1/26

IMPORTANT: Never immerse alternator in cleaning solution. Remove dirt and grease by scraping and using a stiff brush with solvent. Dry with compressed air.

NOTE: Because of the manufacturer's design of the rotor and the field flux noise, this alternator is noisier than others.

Unnecessary disassembly may be prevented by first checking alternator output, shell temperature and pulley nut tension before the decision to disassemble is made. (Refer to your machine Operation and Test manual for complete charging circuit diagnosis.



RW3274 –UN–02MAR90

Remove Dust Cover

A—Dust Cover

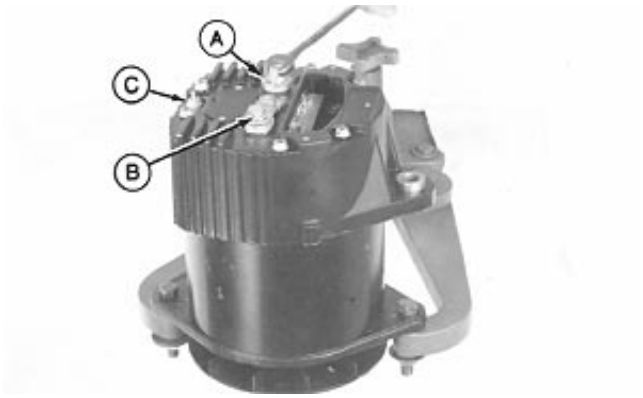
1. Remove dust cover (A).

NOTE: If alternator is being disassembled for testing, follow Steps 1 through 8 only. Refer to TEST NIEHOFF 12-VOLT, 110-AMP ALTERNATOR COMPONENTS, later in this group.

RG,RG34710,2096 –19–15MAR97–2/26

2. Remove battery positive bolt (A), negative bolt (B), and lock nut and insulator from terminal (C).

A—Battery Positive Bolt
B—Negative Bolt
C—Terminal



RW3275 –UN–02MAR90

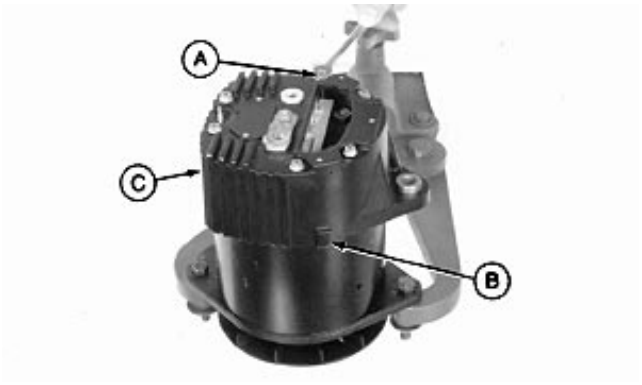
Remove Bolts from Terminal

Continued on next page

RG,RG34710,2096 –19–15MAR97–3/26

3. Remove six lock nuts (A) from studs and pry with screwdriver in detent (B) to lift off rear housing (C).

A—Lock Nuts (6 Used)
B—Detent
C—Rear Housing



RW3276 –UN–02MAR90

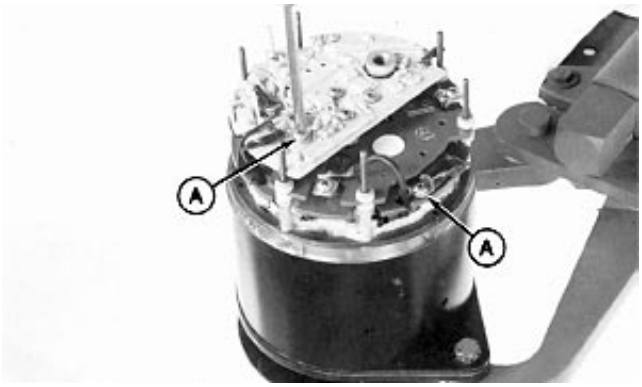
Lift Off Rear Housing

20
10
6

RG,RG34710,2096 –19–15MAR97–4/26

4. Remove two screws (A) to detach compound winding leads.

A—Screws (2 Used)



RW3277 –UN–02MAR90

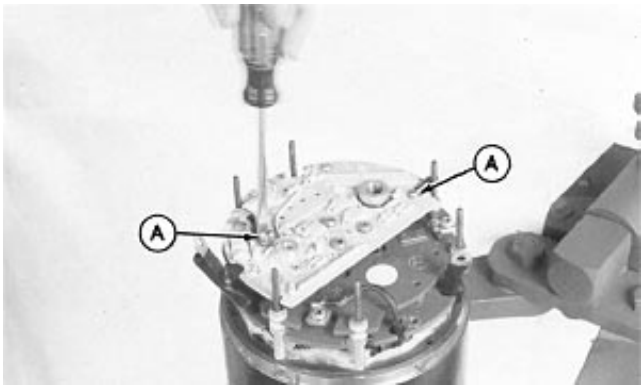
Detach Compound Winding Leads

Continued on next page

RG,RG34710,2096 –19–15MAR97–5/26

5. Remove two screws (A) to detach field leads.

A—Screws (2 Used)

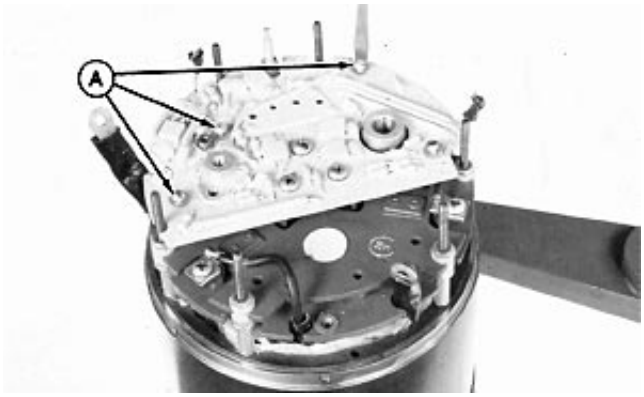


Detach Field Leads

RG,RG34710,2096 –19–15MAR97–6/26

6. Remove three screws (A) with washers at stand-offs.

A—Screws (3 Used)



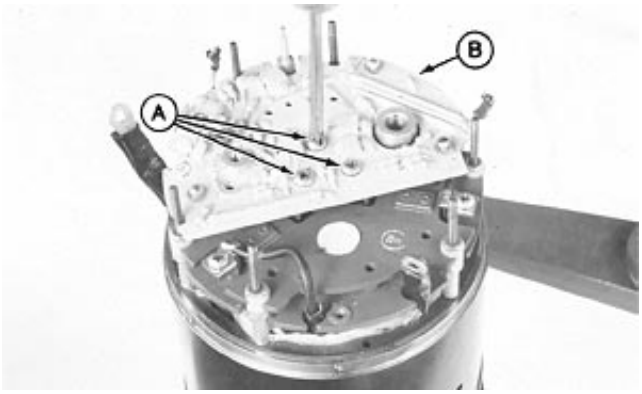
Remove Screws at Stand-Offs

Continued on next page

RG,RG34710,2096 –19–15MAR97–7/26

7. Remove three screws with washers (A) to detach regulator (B).

A—Screws with Washers
B—Regulator



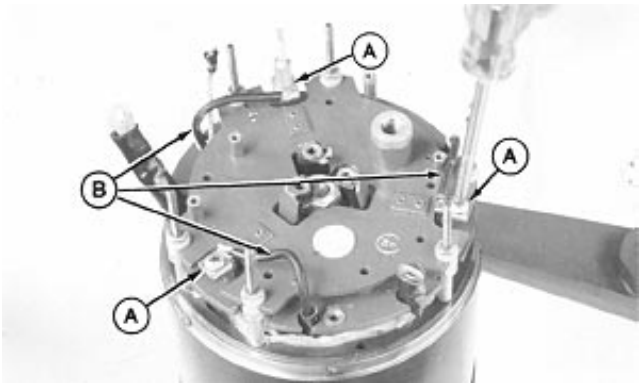
Remove Screws to Detach Regulator

RG,RG34710,2096 –19–15MAR97–8/26

8. Loosen three terminal locks (A) and detach stator leads (B).

NOTE: The alternator has now been disassembled for testing. Refer to TEST NIEHOFF 12-VOLT, 110-AMP ALTERNATOR COMPONENTS, later in this group.

A—Terminal Locks (3 Used)
B—Stator Leads



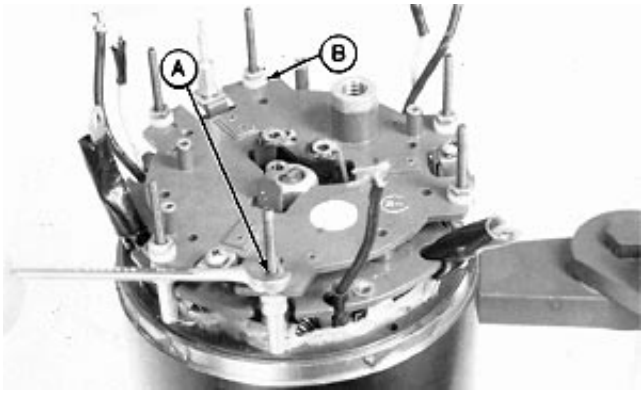
Detach Stator Leads

Continued on next page

RG,RG34710,2096 –19–15MAR97–9/26

9. Remove six nuts (A) and six insulators (B) to detach rectifier assembly.

A—Nuts (6 Used)
B—Insulators (6 Used)



RW3290 –UN–02MAR90

Detach Rectifier Assembly

20
10
9

RG,RG34710,2096 –19–15MAR97–10/26

IMPORTANT: Use soft-jawed vise when clamping pulley.

10. Remove lock nut (A) and hardened washer (B).

A—Lock Nut
B—Hardened Washer

RW3291 –UN–02MAR90

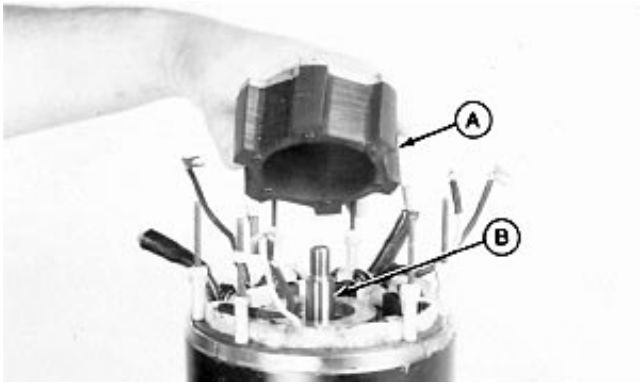
Remove Lock Nut and Washer

Continued on next page

RG,RG34710,2096 –19–15MAR97–11/26

11. Lift rotor (A) from shaft (B).

A—Rotor
B—Shaft



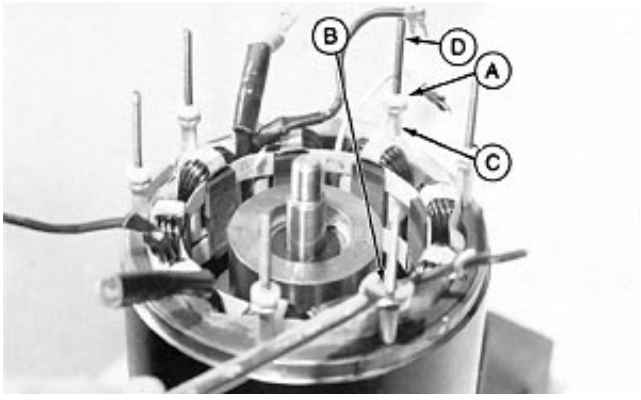
RW3292 –UN–02MAR90

Lift Rotor from Shaft

RG,RG34710,2096 –19–15MAR97–12/26

12. Remove six insulators (A), six washer nuts (B), and six spacers (C) from studs (D).

A—Insulator
B—Washer Nut
C—Spacer
D—Stud



RW3293 –UN–02MAR90

Remove Insulators, Nuts and Spacers

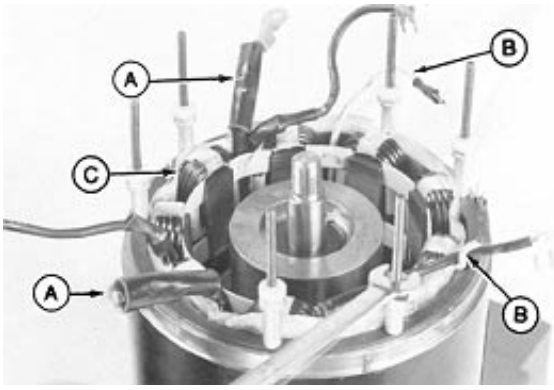
Continued on next page

RG,RG34710,2096 –19–15MAR97–13/26

13. Identify wires for reassembly.

IMPORTANT: Note and mark position of compound winding leads (A) and field winding leads (B) to stator (C). All must be in original position for correct assembly.

A—Compound Winding Leads
B—Field Winding Leads (White)
C—Stator



RW3294 –UN–02MAR90

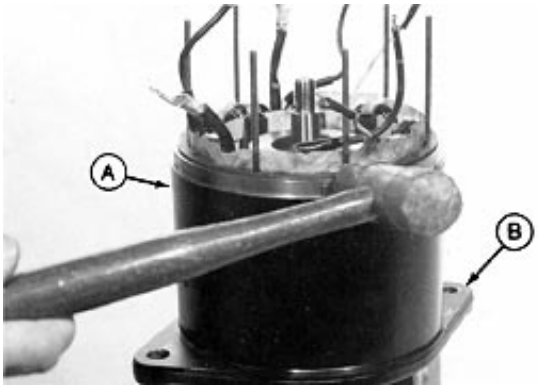
Leads and Stator

20
10
11

RG,RG34710,2096 –19–15MAR97–14/26

14. Tap shell (A) lightly with soft hammer to loosen it from front housing assembly (B).

A—Shell
B—Housing Assembly



RW3295 –UN–02MAR90

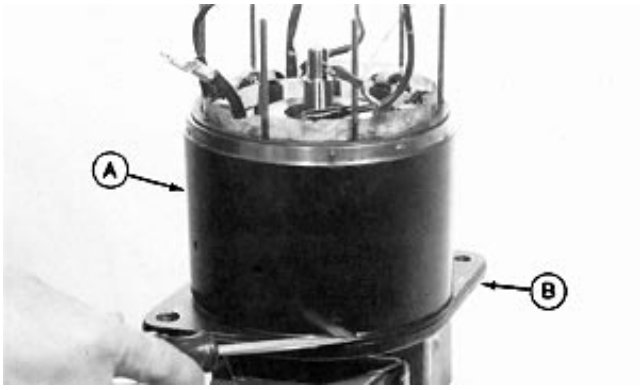
Front Housing Assembly

Continued on next page

RG,RG34710,2096 –19–15MAR97–15/26

15. Pry shell (A) from front housing assembly (B).

A—Shell
B—Housing Assembly



RW3296 –UN–02MAR90

Front Housing Assembly

20
10
12

RG,RG34710,2096 –19–15MAR97–16/26

IMPORTANT: Note and mark the relationship of stator-to-shell before disassembly.

16. Press stator from shell. Use JDG255 Stator Support (A) to support shell (B). Using a punch, tap stator out evenly.

A—JDG255 Stator Support Tool
B—Alternator Shell

RW10426 –UN–10NOV89

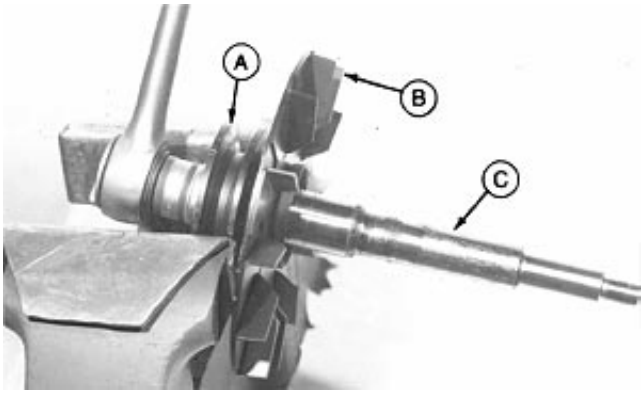
Tap Stator Out

Continued on next page

RG,RG34710,2096 –19–15MAR97–17/26

17. Remove nut and washer to detach pulley (A) and fan (B) from shaft (C).

A—Pulley
B—Fan
C—Shaft



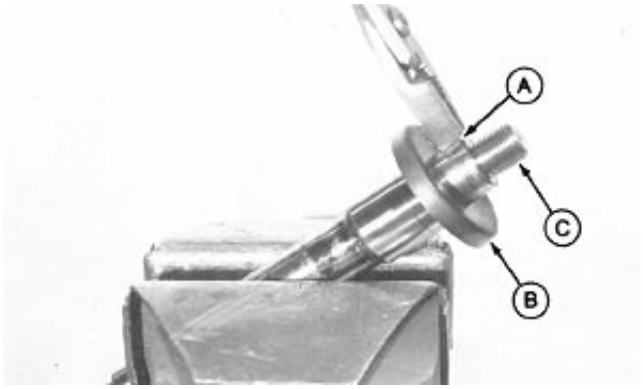
RW3297 –UN–02MAR90

Detach Pulley and Fan

RG,RG34710,2096 –19–15MAR97–18/26

18. Remove Woodruff key (A) to detach bearing seal cover (B) from shaft (C).

A—Woodruff Key
B—Bearing Seal Cover
C—Shaft



RW3298 –UN–02MAR90

Remove Woodruff Key

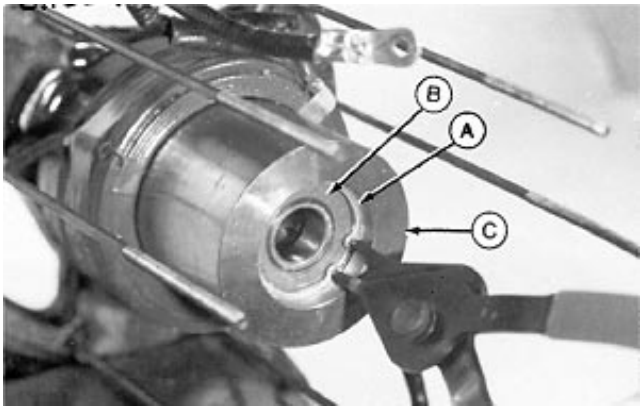
Continued on next page

RG,RG34710,2096 –19–15MAR97–19/26

NOTE: Remove bearings for replacement only, and replace both ball and roller bearings. Bearings are prelubricated by supplier. Use D01061AA Blind Hole Puller Set and ensure full ID contact when removing bearings.

19. Remove snap ring (A).

A—Snap Ring
B—Bearing
C—Shaft



RW5120 –UN–23FEB90

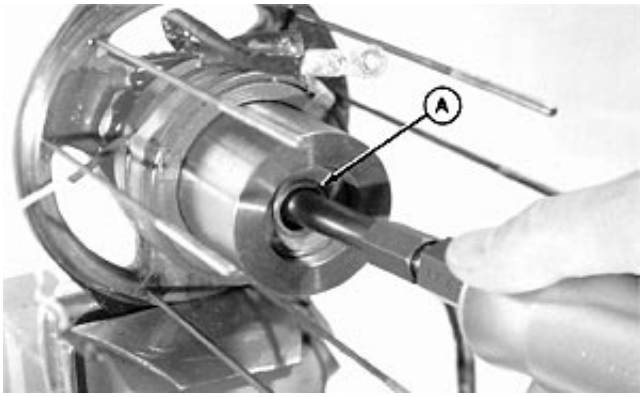
Remove Snap Ring

20
10
14

RG,RG34710,2096 –19–15MAR97–20/26

20. Remove ball bearing (A). Use 16 mm (5/8 in.) collet (No. 33860).[1]

A—Ball Bearing



RW3283 –UN–02MAR90

Remove Ball Bearing

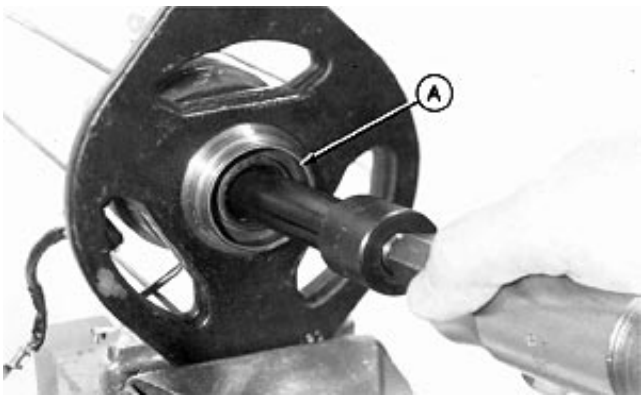
[1]*From the D01061AA Blind Hole Puller Set.*

Continued on next page

RG,RG34710,2096 –19–15MAR97–21/26

21. Remove roller bearing and seal (A). Use 26—32 mm (1—1-1/4 in.) collet (No. 33863).[1]

A—Roller Bearing and Seal



RW3284 –UN–02MAR90

Remove Roller Bearing and Seal

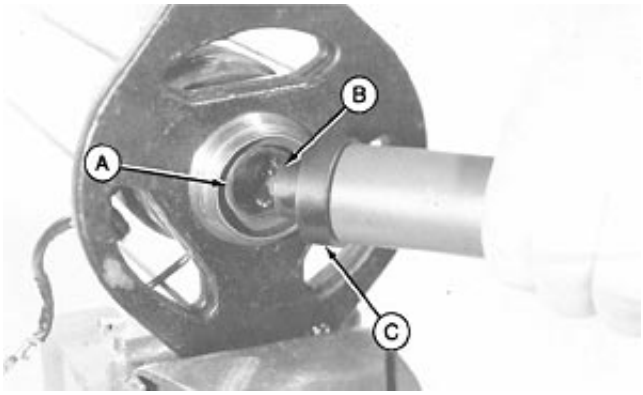
[1]*From the D01061AA Blind Hole Puller Set.*

RG,RG34710,2096 –19–15MAR97–22/26

To install new alternator bearings:

22. Press roller bearing (A) into front housing assembly. Use 27 mm (1-1/16 in.) pilot disk (B) and 46 mm (1-13/16 in.) driver disk (C) (No. 27500 and 27512.)[1]

A—Roller Bearing
B—27 mm (1-1/16 in.) Pilot Disk
C—46 mm (1-13/16 in.) Driver Disk (No. 24500 and 27512.) *



RW3286 –UN–02MAR90

New Alternator Bearings

[1] *From the D01045AA Bushing, Bearing and Seal Driver Set.*

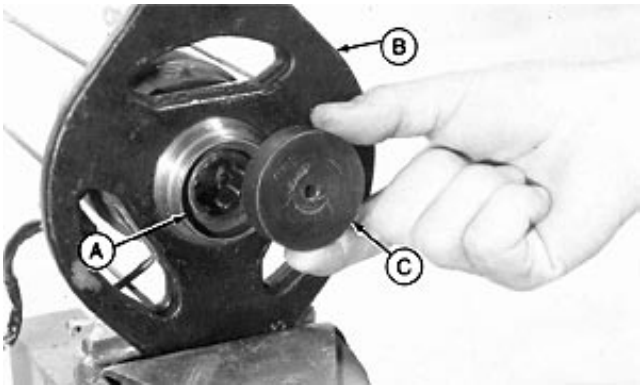
Continued on next page

RG,RG34710,2096 –19–15MAR97–23/26

IMPORTANT: Seal spring and lip must be visible when seal is properly installed for maximum protection against dust penetration into bearing.

23. Press roller bearing seal (A) into front housing assembly (B) using 54 mm (2-1/8 in.) driver disk (C), (No. 27517).[1]

A—Roller Bearing Seal
B—Front Housing Assembly
C—Driver Disk



RW3287 –UN–02MAR90

Roller Bearing Seal

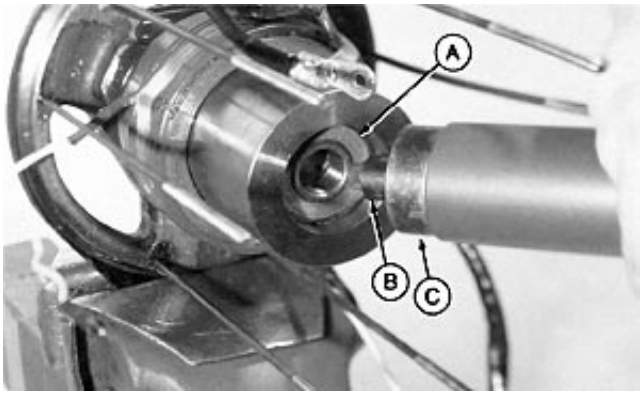
20
10
16

[1] *From the D01045AA Bushing, Bearing and Seal Driver Set.*

RG,RG34710,2096 –19–15MAR97–24/26

24. Press ball bearing (A) into front housing using 16 mm (5/8 in.) disk (B) and 40 mm (1-9/16 in.) driver disk (C) (No. 27493 and 27508).[1]

A—Ball Bearing
B—16 mm (5/8 in.) Disk
C—40 mm (1-9/16 in.) Driver Disk (No. 27493 and 27508)



RW3285 –UN–02MAR90

Ball Bearing

[1] *From the D01045AA Bushing, Bearing and Seal Driver Set.*

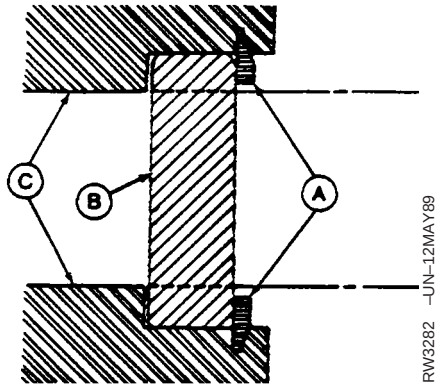
Continued on next page

RG,RG34710,2096 –19–15MAR97–25/26

NOTE: Snap ring (A) must be seated completely with flat side against the bearing (B) (bevel is away from bearing).

25. Assemble snap ring (A) to front housing assembly (C).

A—Snap Ring
B—Bearing
C—Front Housing Assembly



Assemble Snap Ring

20
10
17

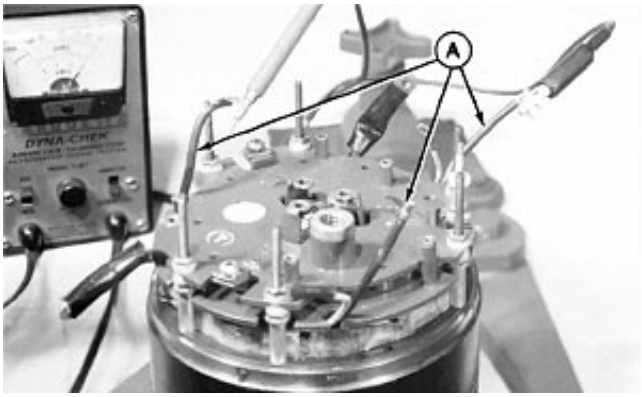
RG,RG34710,2096 –19–15MAR97–26/26

Test Niehoff 12-Volt, 110-Amp Alternator Components

1. Test stator windings by measuring resistance in each successive pair of stator phase leads (A) (three pair). Use JT05791 Digital Multimeter to measure resistance.

   Less than 0.5 ohm of resistance should be indicated in each pair.

A—Stator Phase Leads



Stator Phase Leads

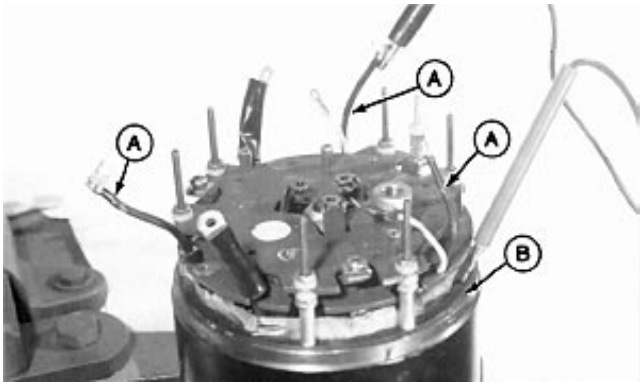
Continued on next page

RG,RG34710,2097 –19–12SEP02–1/9

2. Test for shorted stator windings by measuring resistance between each stator lead (A) and stator frame (B).

   Infinite resistance or “open” should be indicated.

   A—Stator Lead
   B—Stator Frame



RW3266 –UN–02MAR90

Measure Resistance

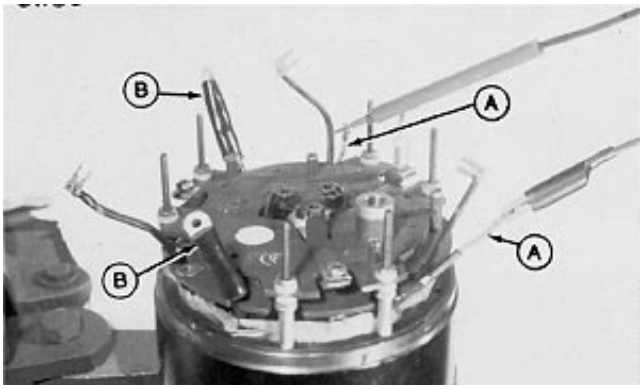
20
10
18

RG,RG34710,2097 –19–12SEP02–2/9

NOTE: A resistance reading above or below specification indicates a defective field winding. Front housing and field coil assembly should be replaced.

3. Test field windings (A) for a resistance of 2.9—3.1 ohms and compound windings (B) for less than 0.5 ohms.

   A—Field Windings
   B—Compound Windings



RW11292 –UN–17APR90

Test Field Windings

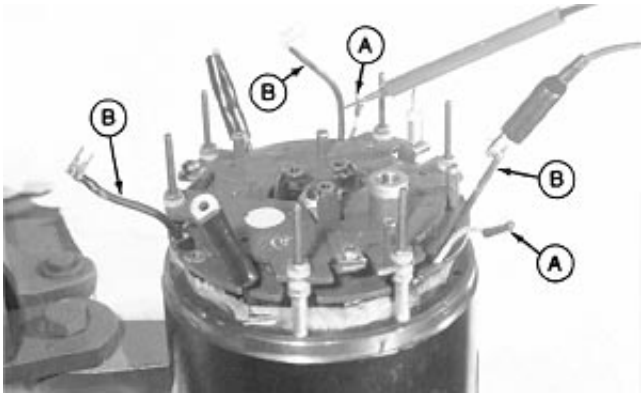
Continued on next page

RG,RG34710,2097 –19–12SEP02–3/9

4. Test for shorted field windings to compound windings by measuring resistance between field leads (A) and compound winding leads (B).

   Infinite resistance or “open” should be indicated. If a short is indicated, the front housing assembly must be replaced.

   A—Field Leads
   B—Compound Winding Leads



RW3268 –UN–02MAR90

Measure Resistance

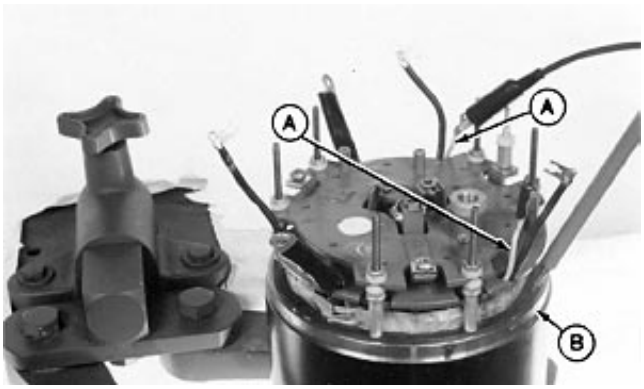
20
10
19

RG,RG34710,2097 –19–12SEP02–4/9

5. Test for shorted field windings to front housing assembly by checking resistance between field leads (A) and front housing/shell assembly (B).

   Infinite resistance or “open” should be indicated. If a short is indicated, the front housing assembly must be replaced.

   A—Field Leads
   B—Front Housing/Shell Assembly



RW3269 –UN–02MAR90

Field Leads and Housing/Shell Assembly

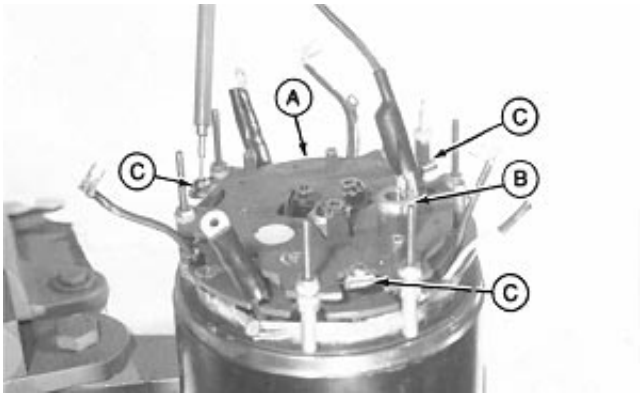
Continued on next page

RG,RG34710,2097 –19–12SEP02–5/9

NOTE: Evidence of defective diodes require replacement of rectifier diode and rectifier assembly. When checking diodes with a digital meter, use the diode position.

6. Test top plate (A) diodes of rectifier assembly by checking resistance between output terminal (B) and each stator phase terminal (C).

   All readings should be of low resistance or infinite resistance, depending on direction of current flow through the diodes.



RW3270 –UN–02MAR90

Test Top Plate Diodes

A—Top Plate
B—Output Terminal
C—Stator Phase Terminal

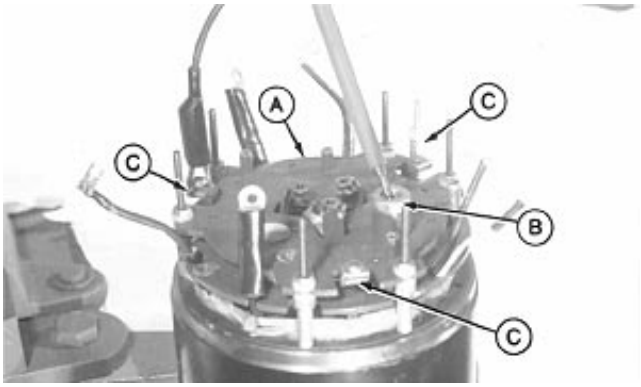
20
10
20

RG,RG34710,2097 –19–12SEP02–6/9

7. Test top plate (A) diodes for reverse current flow by reversing test probes at output terminal. Measure resistance between output terminal (B) and stator phase terminals (C).

   All readings should be the reverse of those in the preceding step.

A—Top Plate
B—Output Terminal
C—Stator Phase Terminal



RW3271 –UN–02MAR90

Test Top Plate Diodes

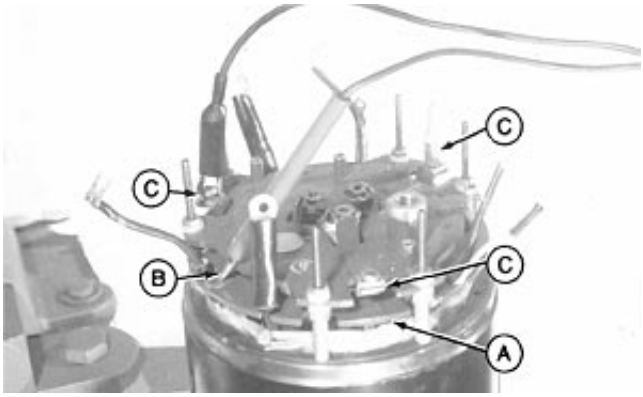
Continued on next page

RG,RG34710,2097 –19–12SEP02–7/9

8. Test the lower plate (A) diodes of the rectifier assembly by checking the resistance between output terminal (B) and stator phase terminals (C).

   All readings should be infinite or low depending on direction of current flow through the diodes.

   A—Lower Plate
   B—Output Terminal
   C—Stator Phase Terminals



RW3272 –UN–02MAR90

Test Lower Plates Diodes

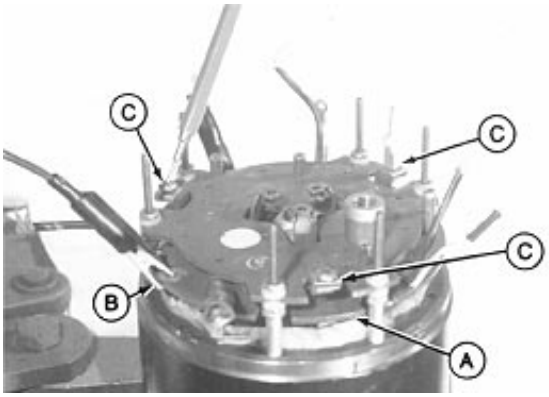
20
10
21

RG,RG34710,2097 –19–12SEP02–8/9

9. Test lower plate (A) diodes for reverse current flow by reversing probes at output terminal (B) and stator phase terminals (C).

   All readings should be the reverse of those in the preceding step.

   Example: An infinite reading in this step should have been a low resistance reading in step 8. If the same reading is indicated in steps 6 and 7 or 8 and 9, defective diodes are evident and the rectifier assembly must be replaced.



RW3273 –UN–02MAR90

Test Lower Plate Diodes

A—Lower Plate
B—Output Terminal
C—Stator Phase Terminal

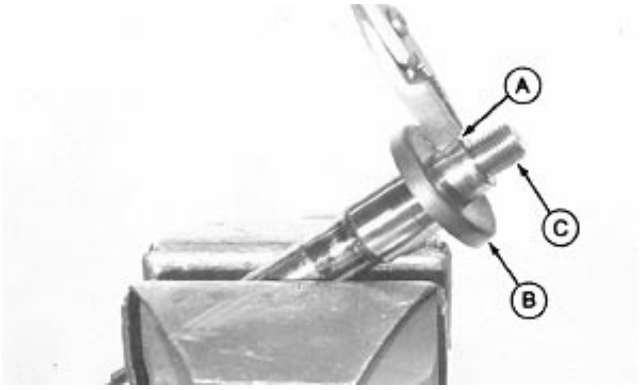
RG,RG34710,2097 –19–12SEP02–9/9

Assemble Niehoff 12-Volt, 110-Amp Alternator

NOTE: Apply LOCTITE® 222 Thread Lock and Sealer (low strength) on all cap screws and nuts when assembling alternator.

1. Assemble roller bearing cover (B) to shaft (C) and insert Woodruff key (A) in slot.

A—Woodruff Key
B—Roller Bearing Cover
C—Shaft



RW3298 –UN–02MAR90

Assemble Roller Bearing Cover

20
10
22

LOCTITE is a registered trademark of Loctite Corp.

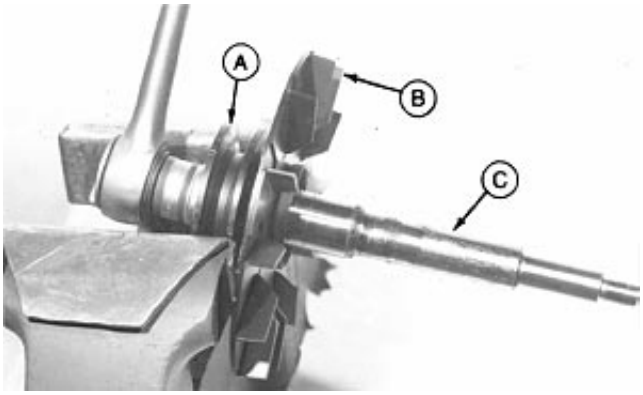
RG,RG34710,2098 –19–15MAR97–1/10

2. Assemble fan (B) and pulley (A) to shaft (C). Tighten lock nut to specifications.

Specification

Fan Pulley Lock Nut—Torque ..... 95 N•m (70 lb-ft)

A—Pulley
B—Fan
C—Shaft



RW3297 –UN–02MAR90

Assembly Fan and Pulley

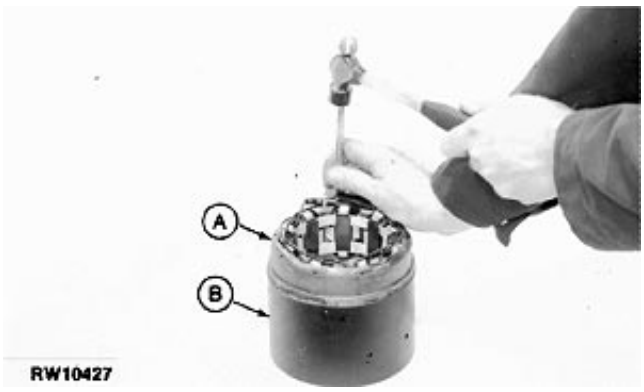
Continued on next page

RG,RG34710,2098 –19–15MAR97–2/10

IMPORTANT: Note your marked position of shell to stator as in disassembly.

3. Assemble stator (A) to shell (B), by tapping evenly around outside edge.

A—Stator
B—Shell



RW10427 –UN–10NOV89

Assemble Stator to Shell

20
10
23

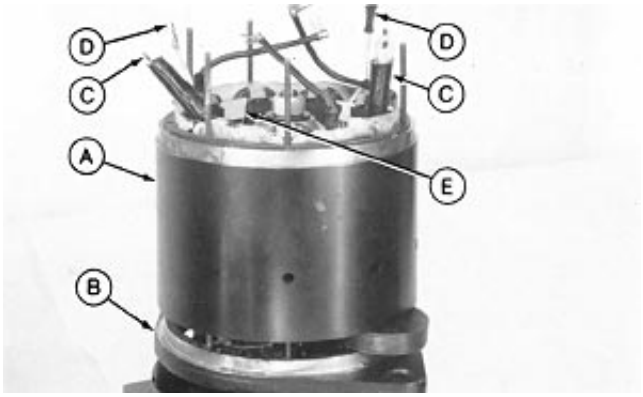
RG,RG34710,2098 –19–15MAR97–3/10

IMPORTANT: Note your marked position of shell (A) to front housing (B) as in disassembly. Also note the way compound winding leads (C) and field winding leads (D) are threaded through stator (E). All must be in the original position before shell is seated onto front housing assembly.

4. Fill front and rear grease reservoir two-thirds full of high temperature, silicone-base grease.

   Assemble shell (A) to front housing (B).

A—Shell
B—Front Housing
C—Compound Winding Lead
D—Field Winding Lead
E—Stator



RW3301 –UN–02MAR90

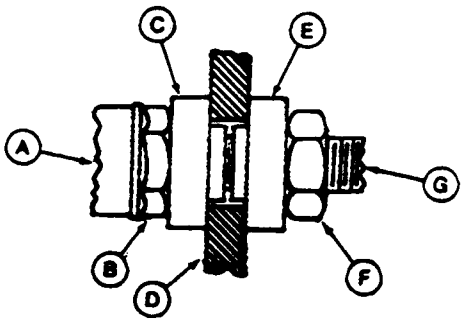
Assemble Shell

Continued on next page

RG,RG34710,2098 –19–15MAR97–4/10

IMPORTANT: Be sure to assemble spacer, nuts, insulators and rectifier assembly to alternator, in the order shown.

A—Spacer
B—Nut
C—Insulator
D—Rectifier Assembly
E—Insulator
F—Nut
G—Stud



RW3299 –UN–12MAY89

Assemble Hardware

20
10
24

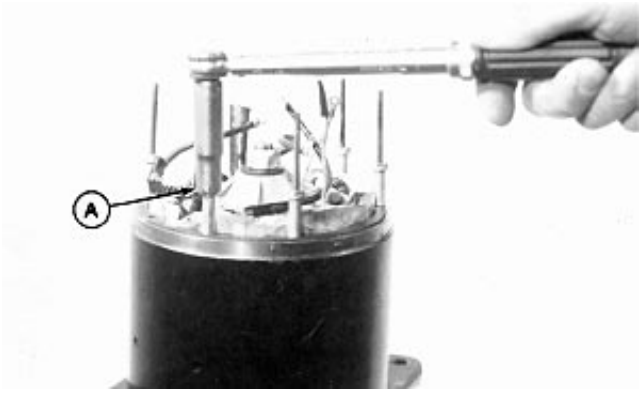
RG,RG34710,2098 –19–15MAR97–5/10

5. Assemble six spacers and six washer nuts. Tighten washer nuts (A) to specifications.

Specification

Front Housing-to-Stator Shell
Nuts—Torque ..... 3.4 N•m (30 lb-in.)

A—Washer Nuts (6 Used)



RW3303 –UN–02MAR90

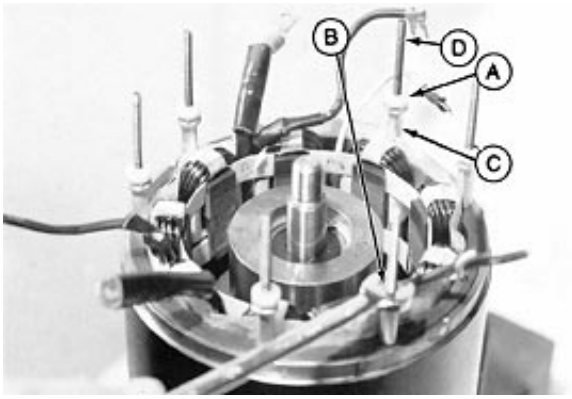
Tighten Washer Nuts

Continued on next page

RG,RG34710,2098 –19–15MAR97–6/10

6. Assemble six insulators (A) to studs (D).

A—Insulators
B—Washer Nuts
C—Spacer
D—Studs



RW3293 –UN–02MAR90

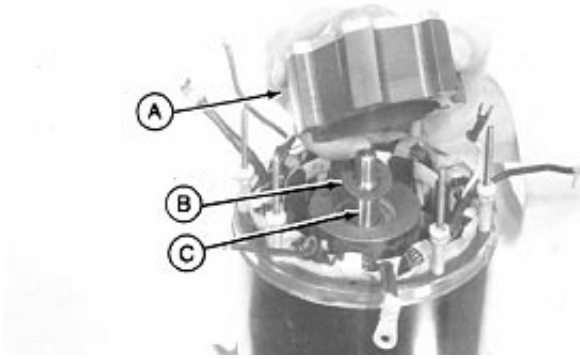
Assemble Insulators

20
10
25

RG,RG34710,2098 –19–15MAR97–7/10

7. Assemble rotor (A) and washer (B) to shaft (C).

A—Rotor
B—Washer
C—Shaft



RW3288 –UN–02MAR90

Assemble Rotor and Washer to Shaft

Continued on next page

RG,RG34710,2098 –19–15MAR97–8/10

8. Assemble hardened washer (B) and nut (A). Tighten to specifications.

Specification

Rotor Nut—Torque ..... 68 N•m (50 lb-ft)

A—Nut
B—Hardened Washer

RW3291 –UN–02MAR90

Hardened Washer and Nut

20
10
26

RG,RG34710,2098 –19–15MAR97–9/10

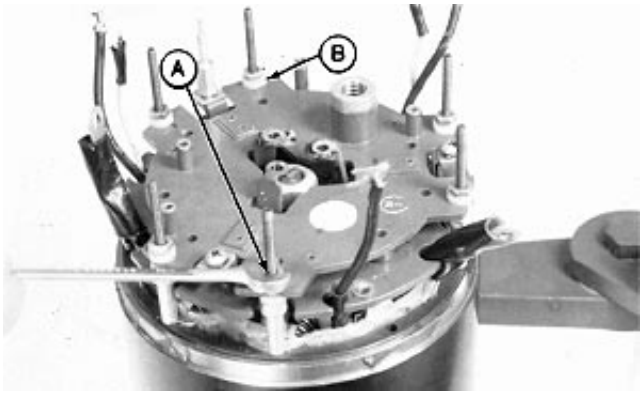
IMPORTANT: Coat all screw heads on regulator and rectifier assembly with silicone rubber compound.

9. Assemble remaining alternator parts in reverse order of disassembly, starting with step 9 back to step 1.

Specification

Regulator Field Lead-to-Standoff Screw and Y-Lead-to-Load Dump Screw—Torque ..... 0.9—1.1 N•m (8—10 lb-in.)
Output and Relay Leads-to-Standoff Screw—Torque ..... 2.3 N•m (20 lb-in.)
Ground Lead-to-Load Dump Screw—Torque ..... 1.1—1.7 N•m (10—15 lb-in.)
Flanged Nuts—Torque ..... 5.1 N•m (45 lb-in.)

10. Refer to your machine technical manual for alternator installation.



RW3290 –UN–02MAR90

Assemble Remaining Parts

A—Nuts (6 Used)
B—Insulators (6 Used)

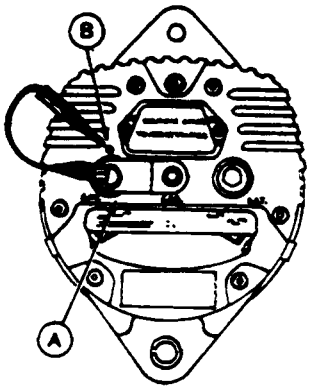
RG,RG34710,2098 –19–15MAR97–10/10

Establish Magnetic Field

NOTE: This action will take only a few seconds.

Connect alternator ground stud (A) to field coil through inspection hole (B) while alternator output is connected to battery positive post and alternator ground is connected to battery negative post.

A—Alternator Ground Stud
B—Inspection Hole



RW3305 –UN–12MAY89

Establish Magnetic Field

20
10
27

RG,RG34710,2099 –19–15MAR97–1/1

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B70 –19–08MAY02–1/5

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUO1004,0000B70 –19–08MAY02–2/5

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

Continued on next page

OUO1004,0000B70 –19–08MAY02–3/5

Blind Hole Puller Set D01061AA

Remove bearings from front housing assembly.

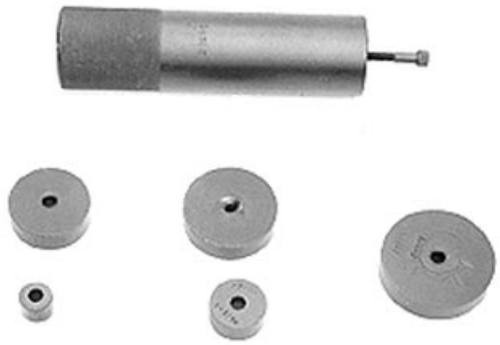
RG11161 –UN–21SEP00

D01061AA

OUO1004,0000B70 –19–08MAY02–4/5

Bushing, Bearing and Seal Driver Set D01045AA

Install bearings in front housing assembly.



RG11162 –UN–21SEP00

D01045AA

OUO1004,0000B70 –19–08MAY02–5/5

Other Material

Number	Name	Use
TY16285 (U.S.) CXTY24311 (Canadian) 222 (LOCTITE®)	Thread Lock and Sealer (Low Strength)	Apply to all cap screws and nuts when assembling alternator.
	High Temperature, Silicone Base Grease	Fill front and rear grease reservoir in alternator housing.
	Silicone Rubber Compound	Apply to all internal wiring lead cap screws.

LOCTITE is a registered trademark of Loctite Corp.

OUO1004,0000B72 –19–21SEP00–1/1

Niehoff 24-Volt Charging Circuit Repair Specifications

Item	Measurement	Specification
Pulley Nut	Torque	95 N•m (70 lb-ft)
Rotor Nut	Torque	75 N•m (55 lb-ft)
Front Housing-to-Stator Nuts	Torque	3.4 N•m (30 lb-in.)
Rotor-to-Stator Poles	Minimum Air Gap	0.13 mm (0.005 in.)
Rotor Housing Stud Ground Lead Nut	Torque	2.8—3.4 N•m (25—30 lb-in.)
Field Lead-to-Regulator Stand-Off Cap Screw	Torque	0.91—1.1 N•m (8—10 lb-in.)
Output and Relay Lead Cap Screws	Torque	2.3 N•m (20 lb-in.)
Ground Lead-to-Load Dump Screw	Torque	1.1—1.7 N•m (10—15 lb-in.)
Y-Lead-to-Load Dump Screw	Torque	0.9—1.1 N•m (8—10 lb-in.)
Load Dump Assembly Mounting Cap Screws	Torque	0.9—1.1 N•m (8—10 lb-in.)
Rear Housing Flange Nuts	Torque	5.1 N•m (45 lb-in.)

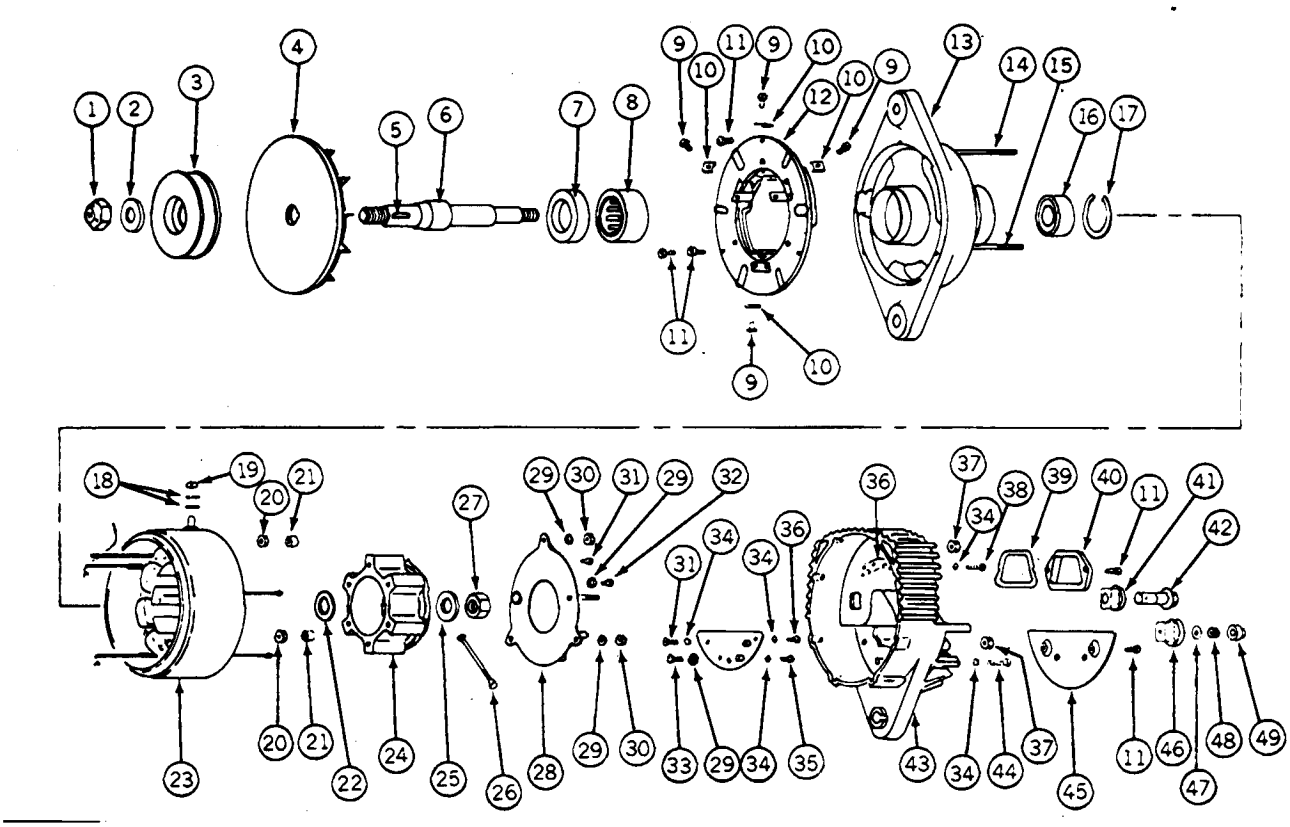
OUO1004,0000B73 –19–21SEP00–1/1

Niehoff 24-Volt Charging Circuit Test Specifications

John Deere Alternator Part No.	Niehoff Alternator Model No.	Ground	Voltage	Rated Output (Amps)	Winding Resistance @ 21—27°C (70—80°F) (Ohms)
AT56873	N-1031	N	24	50	9.0—11.0
AT53676	N-1108	N	24	70—80[a]	11.0—13.0
[a]Alternator output is adjustable on this model.					

RG,RG34710,2102 –19–07JUL05–1/1

Disassemble Niehoff 24-Volt, 50-Amp Alternator and Test Components



Niehoff 24-Volt, 50-Amp Alternator

1—Pulley Nut
2—Hardened Washer
3—Pulley
4—Fan
5—Shaft Key
6—Shaft
7—Shaft Seal
8—Front Bearing
9—Cap Screw (4 Used)
10—Terminal Lock (7 Used)
11—Cap Screw (7 Used)
12—Heat Sink Assembly
13—Front Housing and Field Winding Assembly
14—Shorter Stud
15—Longer Stud (2 Used)
16—Rear Bearing
17—Retaining Ring
18—Flat Washer (2 Used)
19—Lock Nut
20—Flanged Hex Nut (3 Used)
21—Spacer (3 Used)
22—Hardened Washer
23—Stator and Shell Assembly
24—Rotor
25—Hardened Washer
26—Ground Lead
27—Lock Nut
28—Regulator Assembly
29—Spring Washer (4 Used)
30—Double Chamfered Hex Nut (3 Used)
31—No. 6 Cap Screw (2 Used)
32—No. 10 Cap Screw (2 Used)
33—No. 8 Cap Screw
34—Spring Washer (8 Used)
35—No. 6 Cap Screw (3 Used)
36—Insulator
37—Single Flanged Hex Nut (3 Used)
38—No. 6 Cap Screw
39—Gasket
40—Voltage Adjust Cover
41—Red Insulator
42—Output Stud
43—Rear Housing
44—No. 6 Cap Screw
45—Nameplate Cover
46—White Insulator
47—Flat Washer
48—Lock Nut
49—Rubber Relay Terminal Cap

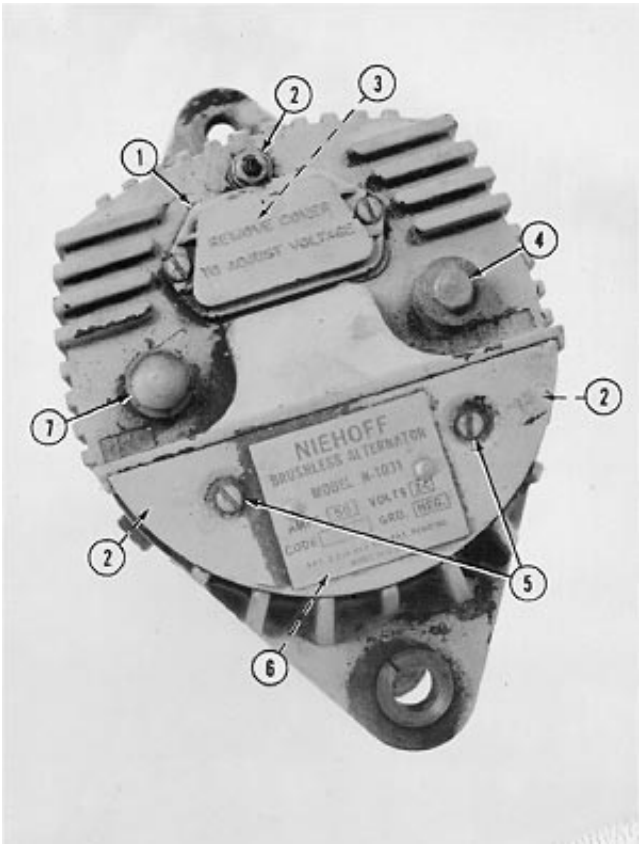
Continued on next page

RG,RG34710,2103 –19–15MAR97–1/13

NOTE: The alternator does not have to be completely disassembled to test components.

1. Remove parts (1—7) to remove cover.

1—Cover
2—Lock Nut (3 Used)
3—Voltage Adjusting Screw
4—Output Terminal
5—Name Plate Cover Cap Screw
6—Regulator Support Screw
7—Relay Terminal



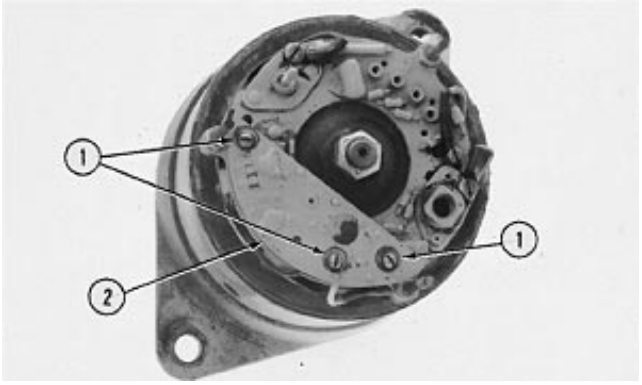
T6090AP –UN–29MAR90

Remove Alternator Parts

RG,RG34710,2103 –19–15MAR97–2/13

2. Remove insulation from screw heads.
3. Remove screws (1) and spring washers.
4. Turn load dump (2) over and remove insulation from wire connections.

1—Screws (3 Used)
2—Load Dump



T6090AT –UN–29MAR90

Load Dump

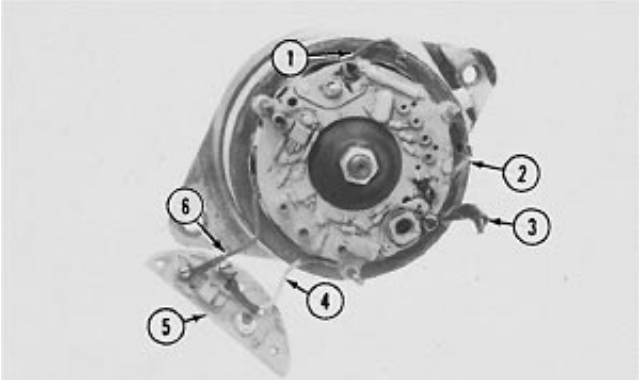
Continued on next page

RG,RG34710,2103 –19–15MAR97–3/13

5. Disconnect wiring leads (4 and 6) to remove load dump (5).

6. Disconnect wiring leads (1, 2, and 3).

1—Relay Lead (Brown)
2—Field Lead (White)
3—Output Lead (Red)
4—Ground Lead (White)
5—Load Dump
6—Y-Lead (Brown)



T6090AO2 –UN–29MAR90

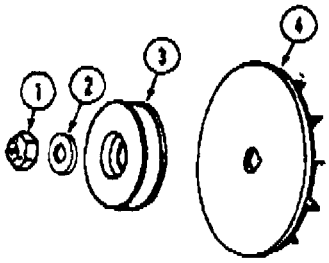
Remove Load Dump

RG,RG34710,2103 –19–15MAR97–4/13

7. Put alternator pulley in a vise. Use an oversize belt on pulley for protection or use a soft-jawed vise.

8. Remove parts (1—4).

1—Nut
2—Hardened Washer
3—Pulley
4—Fan



T6104AB –UN–25MAY89

Remove Parts

Continued on next page

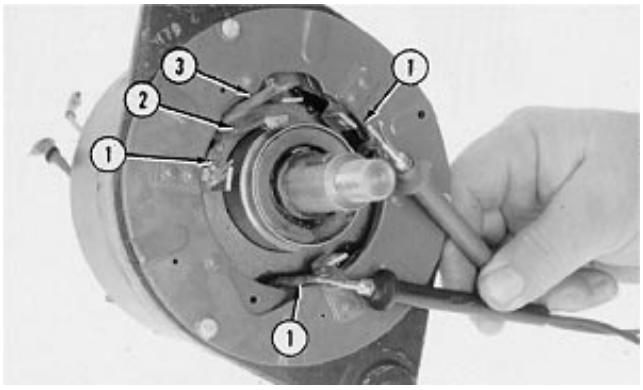
RG,RG34710,2103 –19–15MAR97–5/13

9. Disconnect wire leads (1—3).

10. Adjust ohmmeter to zero and check for continuity between each of the black phase leads (1). If there is no continuity, the stator is open and must be replaced.

11. Check for continuity between each phase lead (1—3) and alternator housing. If there is continuity, the stator is grounded and must be replaced.

1—Black Phase Leads
2—Phase Lead
3—Phase Lead



T6103AH –UN–02APR90

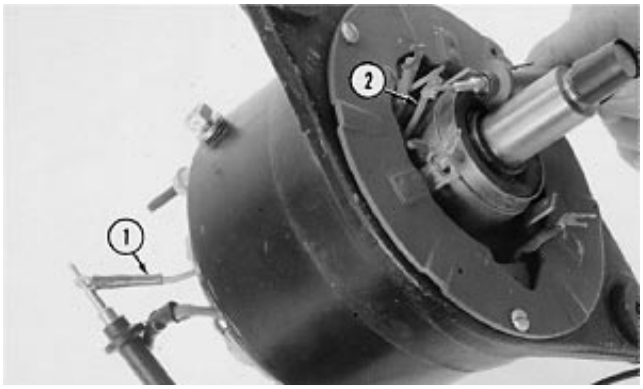
Check for Continuity

RG,RG34710,2103 –19–15MAR97–6/13

12. Adjust ohmmeter to zero. Check for 9—13 ohms resistance between white field lead (1) and thinner red field lead (2). If resistance is not within specification, the coil or assembly must be replaced.

13. Check for continuity between either field lead and alternator housing. If there is continuity, replace the forging and coil assembly and field coil.

1—White Field Lead
2—Red Field Lead



T6103BK –UN–02APR90

Field Leads

Continued on next page

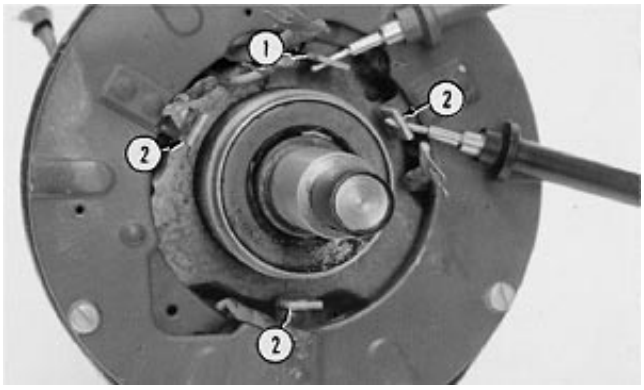
RG,RG34710,2103 –19–15MAR97–7/13

14. Make sure all leads are disconnected from, and are not touching, the heat sink assembly.

15. Check continuity between output terminal (1) and each phase lead terminal (2). All readings should be the same.

16. Reverse leads and repeat step 15. All readings must be opposite of those recorded in step 15. If any reading is the same as in step 15, one or more diodes are defective and heat sink must be replaced.

1—Output Terminal
2—Phase Lead Terminal



T6103BJ –UN–02APR90

Check Continuity

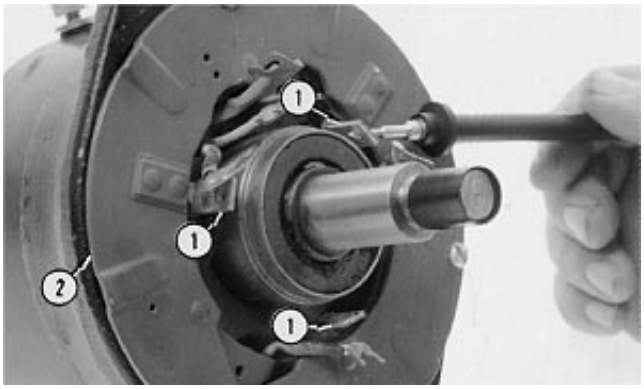
RG,RG34710,2103 –19–15MAR97–8/13

17. Check continuity between phase terminals (1) and alternator housing. All readings must be the same.

18. Reverse probes and repeat step 17. If any reading is the same as in step 17, a diode is defective and the heat sink must be replaced.

19. Remove heat sink (2).

1—Phase Terminals
2—Heat Sink



T6103BH –UN–02APR90

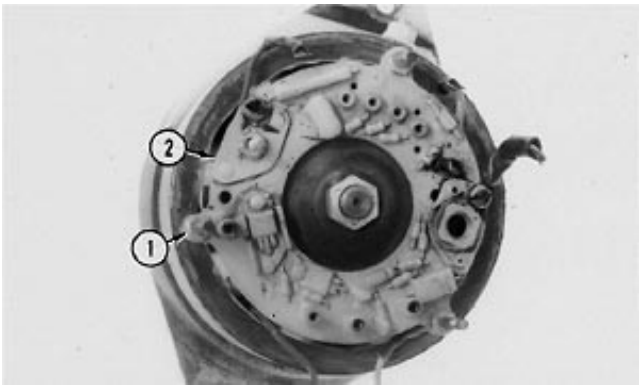
Check Continuity

Continued on next page

RG,RG34710,2103 –19–15MAR97–9/13

20. Remove nuts (1) to remove regulator (2).

1—Nuts
2—Regulator



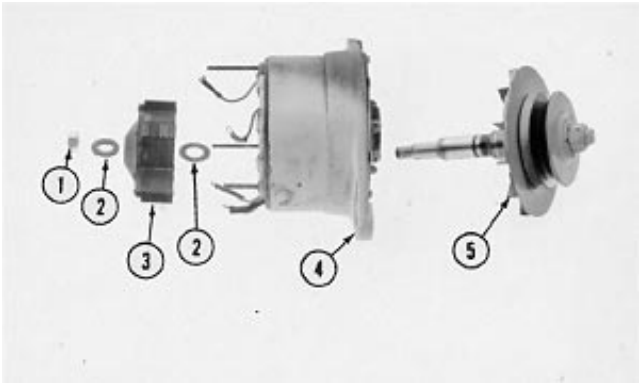
T6090AO1 –UN–29MAR90

Remove Nuts to Remove Regulator

RG,RG34710,2103 –19–15MAR97–10/13

21. Remove parts (1—5).

1—Nut
2—Special Washer (2 Used)
3—Rotor
4—Alternator
5—Shaft Assembly



T6090AU –UN–29MAR90

Remove Parts

Continued on next page

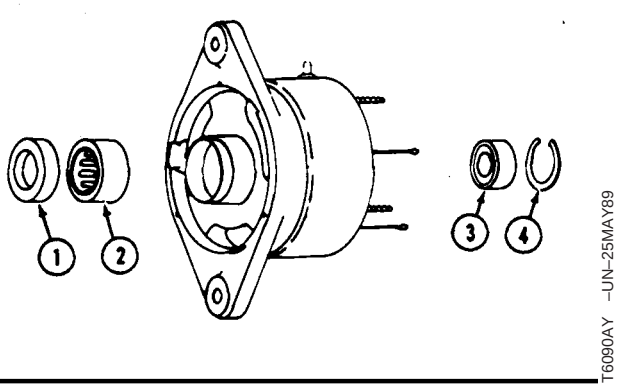
RG,RG34710,2103 –19–15MAR97–11/13

NOTE: Remove bearings and seal only for replacement.

22. Remove shaft seal (1) and front bearing (2) using a D01061AA Blind Hole Puller Set.

23. Remove snap ring (4) and rear bearing (3).

1—Shaft Seal
2—Front Bearing
3—Rear Bearing
4—Snap Ring



T6090AY –UN–25MAY89

Remove Bearings

20
15
11

RG,RG34710,2103 –19–15MAR97–12/13

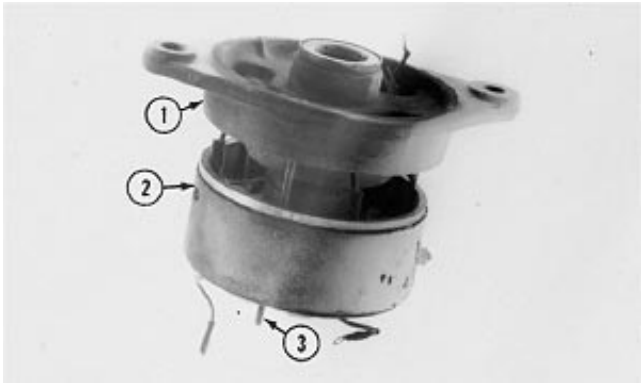
24. Remove nuts from studs (3).

25. Hold front housing (1) upward and lightly tap housing using a soft-faced hammer to remove shell (2).

NOTE: DO NOT soak front housing in solvent; wipe with clean cloth.

26. Clean and inspect all parts for damage. Replace parts as necessary.

1—Front Housing
2—Shell
3—Studs



T6090AL1 –UN–29MAR90

Clean and Inspect Parts

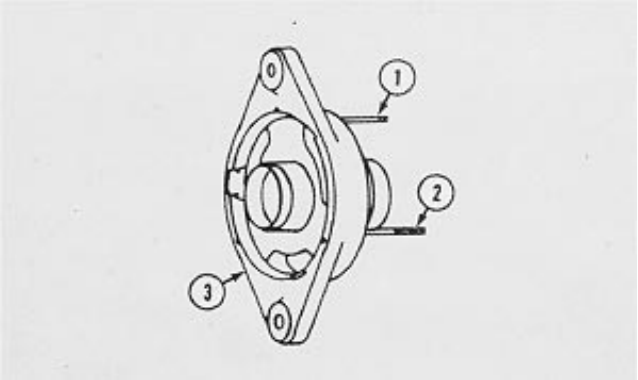
RG,RG34710,2103 –19–15MAR97–13/13

Assemble Niehoff 24-Volt, 50-Amp Alternator

NOTE: Apply LOCTITE® 222 Thread Lock and Sealer (low strength) on all cap screws and nuts when assembling alternator.

1. Install short threaded end of studs (1 and 2) into housing (3). Install shorter stud (1) in hole below mounting ear.

1—Shorter Stud
2—Longer Stud
3—Housing



T6099AP –UN–29MAR90

Assemble Alternator

20
15
12

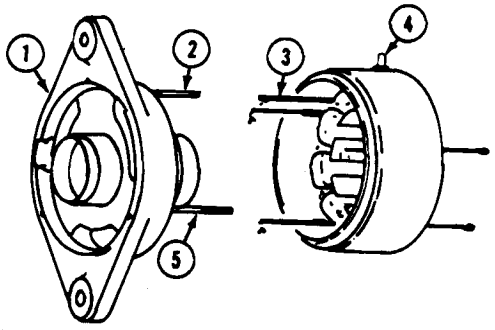
LOCTITE is a registered trademark of Loctite Corp.

RG,RG34710,2104 –19–15MAR97–1/9

2. Align ground terminal (4) with shorter stud (2) and phase and output leads (3) toward front housing (1).
3. Put shell assembly on stud.
4. Put phase and output leads (3) through opening in front housing (1).
5. Push shell assembly against housing.
6. Tap shell with a soft-faced hammer until shell seats in front housing.

IMPORTANT: If the thicker stud nuts are not used, the regulator support screw and threads will engage when installing cover.

7. Loosely install three thicker flange head nuts.



T6099AQ –UN–25MAY89

Shell Assembly

1—Front Housing and Field Winding Assembly
2—Shorter Stud
3—Phase and Output Leads
4—Ground Terminal
5—Longer Stud (2 Used)

Continued on next page

RG,RG34710,2104 –19–15MAR97–2/9

8.

Fill front and rear grease reservoir two-thirds full of high-temperature, silicone-base grease.

9. Press front bearing (3) into housing (4) using a 44 mm disk (1) (from D01045AA Bushing, Bearing and Seal Driver Set) and press.

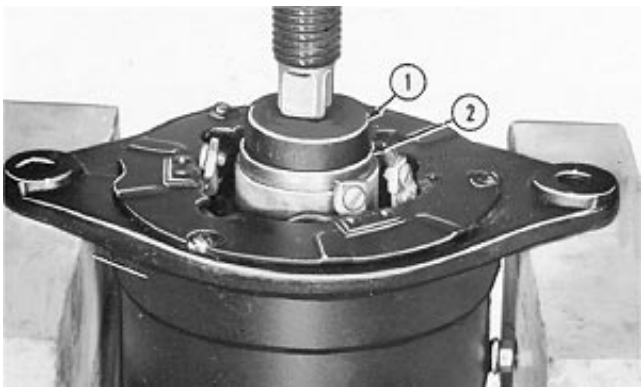
10. Put high-temperature, silicone-base grease on seal lip and fill space between front bearing and seal.

11. Position seal (2) with open side toward front bearing and press seal into housing using a 44 mm disk (1).

12. Position rear bearing (5) with open side toward housing.

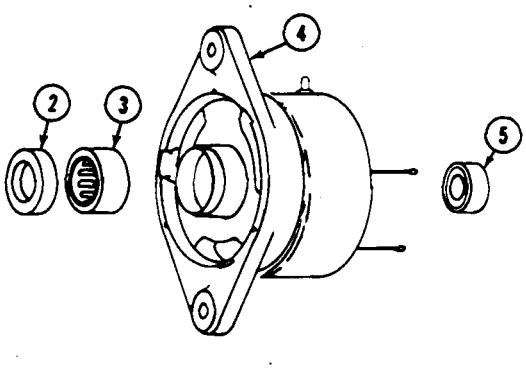
13. Press rear bearing into alternator using a 38 mm disk and press.

1—44 mm Disk
2—Seal
3—Front Bearing
4—Alternator Housing
5—Rear Bearing



T6093AG –UN–29MAR90

Press Seal into Housing



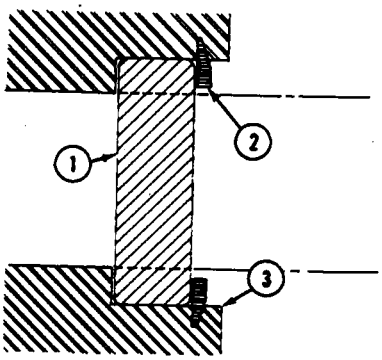
T6093AH –UN–25MAY89

Position Rear Bearing

RG,RG34710,2104 –19–15MAR97–3/9

14. Install snap ring (2) with flat side against bearing (1) in housing core (3).

1—Bearing
2—Snap Ring
3—Housing Core



T6090AV –UN–25MAY89

Install Snap Ring

Continued on next page

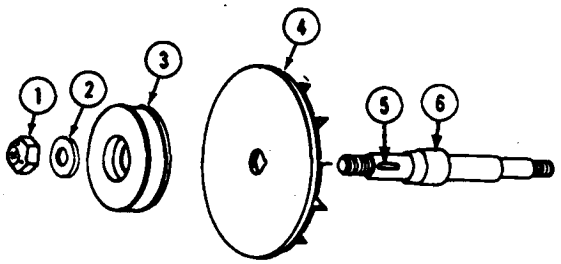
RG,RG34710,2104 –19–15MAR97–4/9

15. Install key (5) in shaft (6).

16. Assemble parts (1—6) and tighten nut (1) to specifications.

Specification	
Pulley Nut—Torque	95 N•m (70 lb-ft)

17. Put high-temperature, silicone-base grease on shaft large area.



T6099AO –UN–25MAY89

Assemble Parts

1—Pulley Nut
2—Special Washer
3—Pulley
4—Fan
5—Shaft Key
6—Shaft

20
15
14

RG,RG34710,2104 –19–15MAR97–5/9

18. Carefully put shaft assembly (5) in front housing (4).

19. Assemble parts (1—3) and tighten rotor nut to specifications.

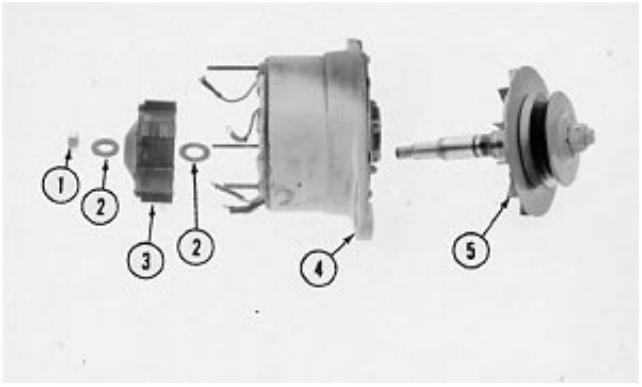
Specification	
Rotor Nut—Torque	75 N•m (55 lb-ft)

IMPORTANT: Correct rotor-to-stator clearance is essential to operation of alternator.

20. Put a 25 x 76 mm (1 x 3 in.) piece of 0.2 mm (0.008 in.) shim stock between each pole of the rotor and adjacent poles of stator.

IMPORTANT: Shims must not overlap.

21. Move stator in shell for best free movement of shims.



T6090AU –UN–29MAR90

Assemble Parts

1—Rotor Nut
2—Special Washer (2 Used)
3—Rotor
4—Front Housing and Field Winding Assembly
5—Shaft Assembly

Continued on next page

RG,RG34710,2104 –19–15MAR97–6/9

22. Tighten the three thicker flange hex nuts (2) to specifications.

Specification

Front Housing-to-Stator Nuts—
Torque ..... 3.4 N•m (30 lb-in.)

23. Remove shims and check air gap between rotor and stator poles.

Specification

Rotor-to-Stator Poles—Minimum
Air Gap ..... 0.13 mm (0.005 in.)

24. Install spacers (3).

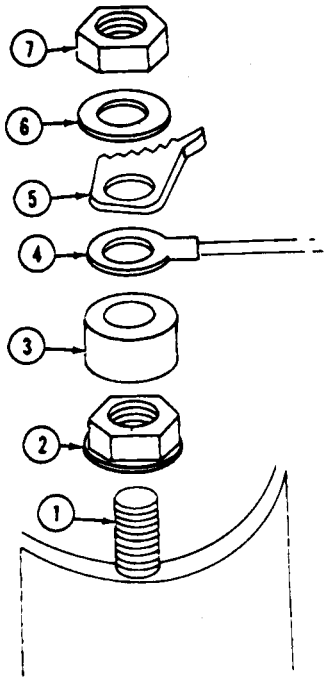
25. Put white ground lead (4) on longer stud on alternator right side.

26. Install regulator assembly (5) on studs with the four voltage adjustment stand-offs toward ground terminal.

27. Install spring washers (6) and nuts (7). Tighten to specifications.

Specification

Rotor Housing Stud Ground Lead
Nut—Torque ..... 2.8—3.4 N•m (25—30 lb-in.)



T6090AW –UN–25MAY89

Assemble Parts

1—Stud
2—Flange Hex Nut (3 Used)
3—Spacer (3 Used)
4—Ground Lead (White)
5—Regulator
6—Spring Washer (3 Used)
7—Double Chamfered Nut (3 Used)

Continued on next page

RG,RG34710,2104 –19–15MAR97–7/9

28. Attach field lead (2) to regulator stand-off. Tighten screws to specifications.

Specification
Field Lead-to-Regulator Stand-Off Cap Screw—Torque ..... 0.91—1.1 N•m (8—10 lb-in.)

29. Install output leads (3), relay lead (1), spring washers, and screws. Tighten screws to specifications.

Specification
Output and Relay Lead Cap Screws—Torque ..... 2.3 N•m (20 lb-in.)

30. Install ground lead (4), spring washer, and screw. Tighten screw to specifications.

Specification
Ground Lead-to-Load Dump Screw—Torque ..... 1.1—1.7 N•m (10—15 lb-in.)

31. Install Y-lead (6), spring washer, and screw. Tighten screw to specifications.

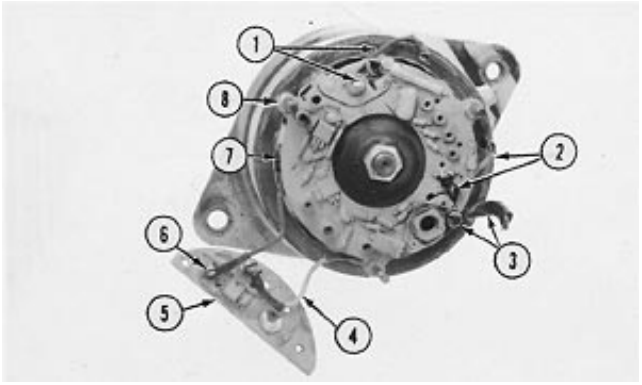
Specification
Y-Lead-to-Load Dump Screw—Torque ..... 0.9—1.1 N•m (8—10 lb-in.)

32. Put silicone rubber compound on all connections.

33. Install load dump, spring washers, and screws. Tighten screws to specifications.

Specification
Load Dump Assembly Mounting Cap Screws—Torque ..... 0.9—1.1 N•m (8—10 lb-in.)

34. Put silicone rubber compound on load dump screws.



T6090AO –UN–29MAR90

Leads

1—Relay Lead (Brown)
2—Field Lead (White)
3—Output Lead (Red)
4—Ground Lead (White)
5—Load Dump Assembly
6—Y- Lead (Brown)
7—Regulator
8—Nut (3 Used)

Continued on next page
RG,RG34710,2104 –19–15MAR97–8/9

35. Install housing and tighten nuts (2) to specifications.

Specification

Rear Housing Flange Nuts—
Torque ..... 5.1 N•m (45 lb-in.)

36. Install voltage adjusting screw (3), spring washer, and cover (1).

37. Install regulator support screw (6) and spring washer.

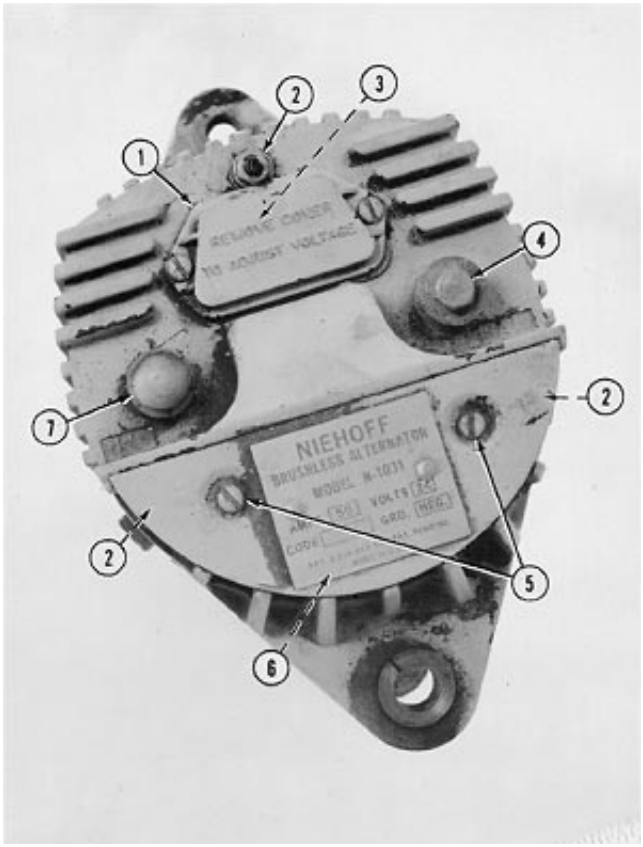
38. Install plate cover and screws (5).

39. Install flat washer, nut and cover on relay terminal (7).

40. Install output stud (4).

41. If rotor and stator were removed from alternator during repair, the magnetic field must be re-established. (See REESTABLISHING MAGNETIC FIELD, later in this group.)

42. Install alternator. (See your machine technical manual.)



T6090AP –UN–29MAR90

Components

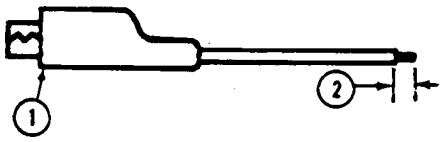
1—Cover
2—Lock Nut (3 Used)
3—Voltage Adjusting Screw
4—Output Terminal
5—Name Plate Cover Cap Screw
6—Regulator Support Screw
7—Relay Terminal

RG,RG34710,2104 –19–15MAR97–9/9

Re-Establish Magnetic Field

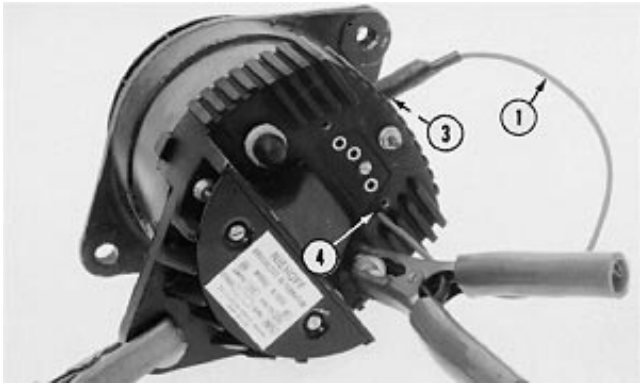
1. Remove voltage adjustment cover.
2. Connect battery positive terminal to alternator output and battery negative terminal to alternator ground.
3. Make a jumper wire (1) with an alligator clamp. Remove 1.5 mm (1/16 in.) of insulation (2) from end of wiring lead.
4. Connect clamp to ground stud (3) and put the other end of wiring lead momentarily into hole (4) in end of housing.
5. Remove jumper wire. Disconnect cables and install cover.
6. After alternator is installed, check that magnetic field has been established. Turn key switch on, then check voltage reading (battery voltage) on voltmeter.

   Start engine, then check voltage reading (charging voltage) on the voltmeter. Charging voltage must be higher than battery voltage to indicate magnetic field has been established.



T6100AV –UN–25MAY89

Jumper Wire and Insulation



T6100AU –UN–29MAR90

Ground Stud

1—Jumper Wire
2—1.5 mm (1/16 in.)
3—Ground Stud
4—Hole In Housing

RG,RG34710,2105 –19–15MAR97–1/1

Section 25
Denso Alternators

Contents

Denso Alternator Operation

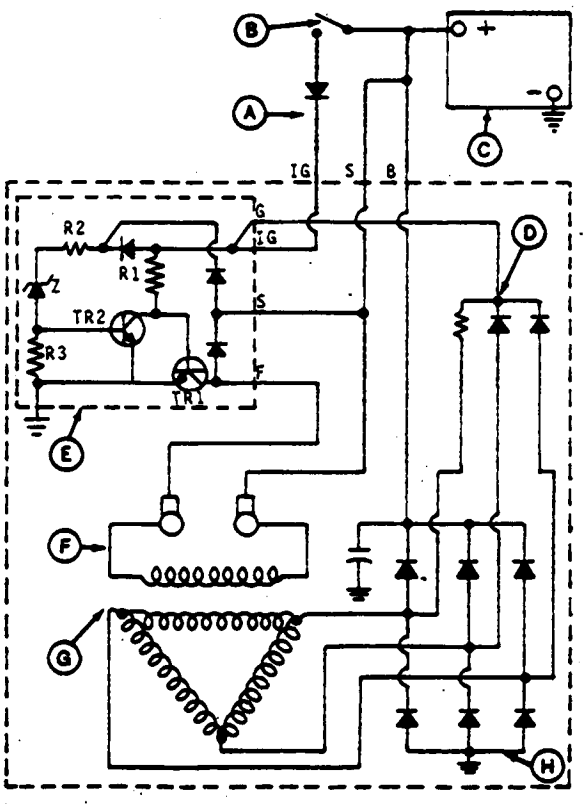
The drawing at right shows alternator circuitry. Schematic of regulator (E) has been simplified.

An alternator (unlike generator) uses a rotating magnetic field with stationary windings. The magnetic field is externally excited. This means that it requires an outside current source. The rotor (F) consists of two interlocking soft iron sections and a wire coil wrapped around an iron core. When current is passed through the wire coil, the rotor becomes an electromagnet.

The rotating magnetic field induces an alternating current in the stator windings (G). This is converted to direct current by six diodes in the rectifier bridge (H).

A capacitor inside rear housing protects rectifier bridge and diode trio (D) from voltage surges. It also suppresses radio interference.

This alternator uses an “A” field circuit with regulator located after field. Full output is obtained by grounding field.



Denso Alternator Operation

A—Diode
B—Switch
C—Battery
D—Diode Trio
E—Regulator
F—Rotor (Field)
G—Stator
H—Rectifier Bridge

RG,RG34710,2106 –19–15MAR97–1/1

25
05
1

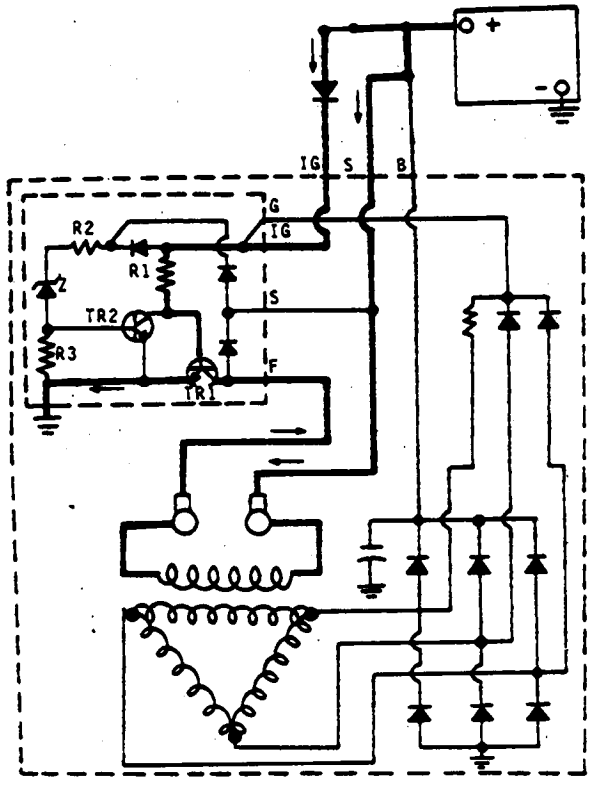
Denso Regulator Operation

The solid-state regulator is mounted inside the alternator. It controls output by controlling the current through the field. In operation, the regulator has the following three phases.

Phase I—Alternator Stopped

(Phase I also applies when alternator is running but only if not running fast enough for output to exceed battery voltage.)

1. Current flows from battery through key switch and diode to terminal IG.
2. From there, current flows through resistor R1 to transistor TR1 and turns it on.
3. Transistor TR1 then provides a path to ground so current can flow through field, enabling alternator to generate electricity.
4. Zener diode Z prevents flow of current from terminal IG to transistor TR2. A Zener diode is a special type of diode which will not permit current to pass until voltage reaches a certain preset level. If voltage exceeds that level, current can pass through the Zener diode.



Phase I—Alternator Stopped

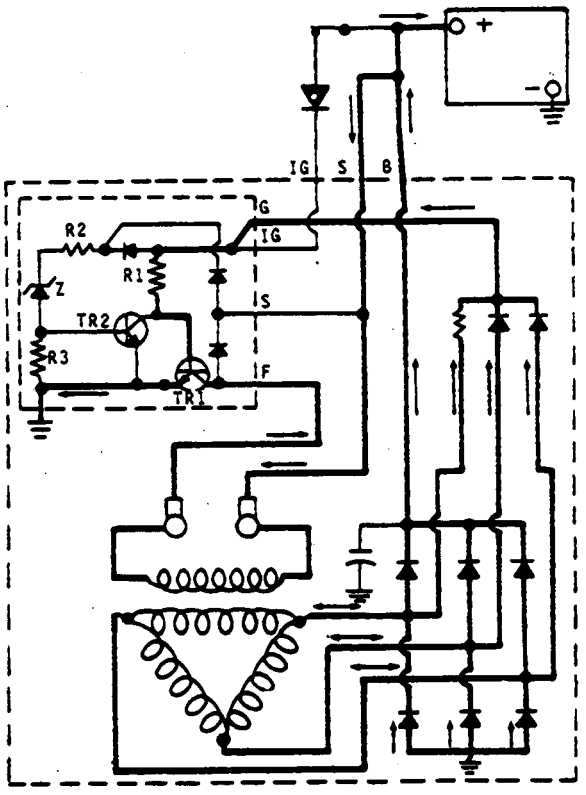
25
05
2

Continued on next page

RG,RG34710,2107 –19–18OCT00–1/3

Phase II—Generating Electricity

1. The diode trio, key switch, rectifier bridge, and terminal 1 all have equal voltage. Therefore, no current flows through diodes.
2. Current, now coming from diode/resistor trio, still flows through resistor R1 to turn on transistor TR1.
3. Transistor TR1 still provides a path to ground so current can flow through field, enabling alternator to generate electricity.
4. Since the field is rotating, it does generate electricity. Alternating current is induced in the stator windings. The rectifier bridge converts it to direction current, providing current to run electrical accessories and charge batteries.
5. Output voltage still has not reached critical voltage of Zener diode Z, so no current can flow from terminal 2 to transistor TR2.



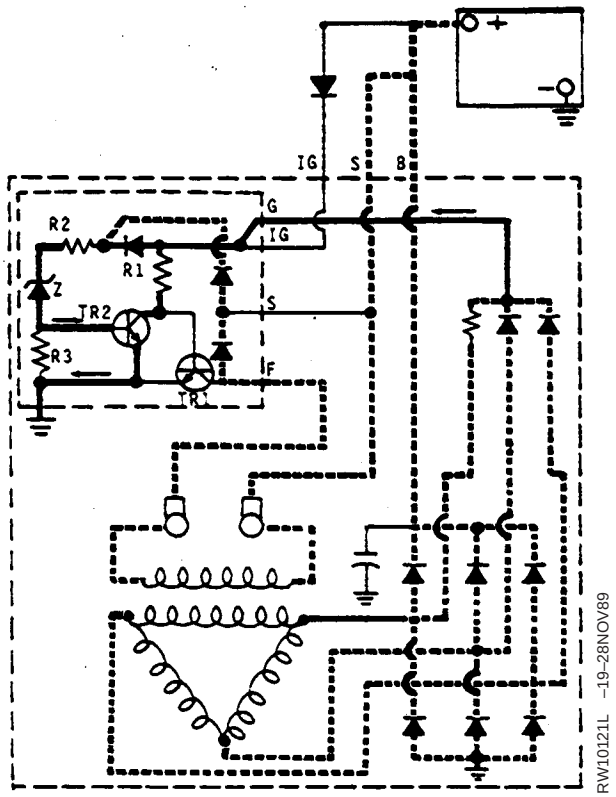
Phase II—Generating Electricity

RG,RG34710,2107 –19–18OCT00–2/3

25
05
3

Phase III—Shut-Off

1. Output voltage reaches critical voltage of Zener diode Z.
2. Current can now pass through Zener diode Z to turn on transistor TR2.
3. Transistor TR2 now provides a direct path to ground for any current coming through resistor R1.
4. This cuts off the current to transistor TR1, turning it off. There is now no path to ground for current through field.
5. Current through field is shut off instantly, and alternator stops generating electricity.
6. Phases II and III are repeated many times per second to maintain voltage at proper level.



Phase III—Shut-Off

RG,RG34710,2107 –19–18OCT00–3/3

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B74 –19–08MAY02–1/4

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

25
10
1

OUO1004,0000B74 –19–08MAY02–2/4

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000B74 –19–08MAY02–3/4

Alternator Pulley Tool Set JD306A

Remove and install alternator pulley retaining nut.

RG12198 –UN–17JUL02

JD306A

OUO1004,0000B74 –19–08MAY02–4/4

Other Material

Number	Name	Use
	Chevron SR1-2 Grease	Lubricate alternator bearings.
	400-Grit Silicon Carbide Paper or 00 Sandpaper	Polish slip rings.

OUO1004,0000B76 –19–21SEP00–1/1

Denso Charging Circuit Repair Specifications (Alternators with Add-On Regulator)

Item	Measurement	Specification
Used Brushes	Minimum Exposed Length	6 mm (0.25 in.)
New Brushes	Exposed Length	16 mm (0.625 in.)
Pulley Nut	Torque	66—87 N•m (50—65 lb-ft)

25
10
2

OUO1004,0000B77 –19–21SEP00–1/1

Denso Charging Circuit Test Specifications (Alternators with Add-On Regulator)

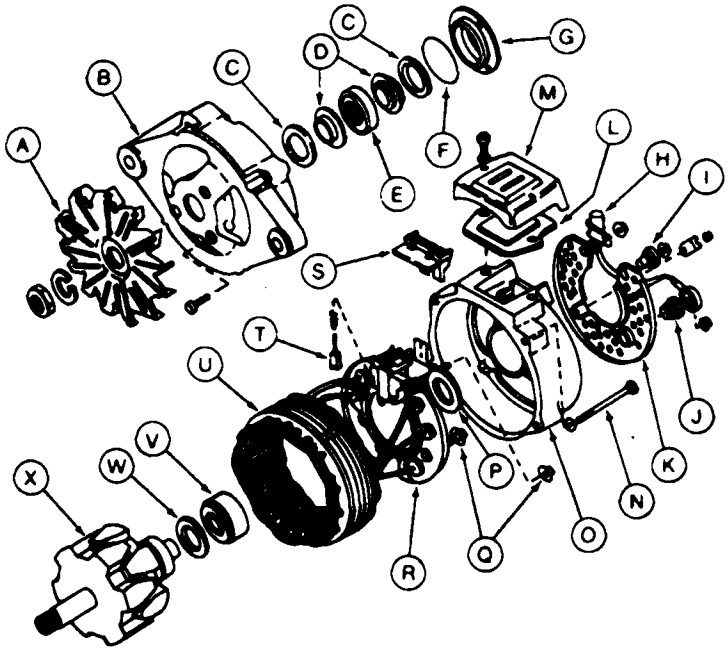
John Deere Alternator Part No.	Denso Alternator Part No.	Voltage	Rated Output (Amps)
AN193461	100211—5800	12	90
AR87205	100211—0081	12	90
AR93448	100211—0290, 100211—0291	12	90
AT103789	100211—0292	12	90

Item	Specification
Regulator Output Voltage	13.8—14.8 volts

NOTE: Earlier Denso alternators may have the original Nippondenso label.

RG,RG34710,2110 –19–07JUL05–1/1

Disassemble Denso Alternator with Add-On Regulator and Test Components



R31563 –UN–13APR89

Denso Alternator

A—Fan
B—Front Housing
C—Felt Washer (2 Used)
D—Collar (2 Used)
E—Front Bearing
F—O-Ring
G—Bearing Retainer
H—Condenser
I—Insulating Bushing
J—Insulating Bushing
K—Rear Cover
L—Voltage Regulator
M—Regulator Cover
N—Through Bolt (4 Used)
O—Rear Housing
P—Felt Washer
Q—Insulating Bushings
R—Rectifier Bridge
S—Insulator
T—Brush (2 Used)
U—Stator
V—Rear Bearing
W—Felt Washer
X—Rotor

Disassemble alternator only after making an external examination and performing alternator tests outlined in your machine technical manual.

Refer to your machine technical manual for removal of alternator from engine.

IMPORTANT: Never immerse alternator in cleaning solvent. Remove dirt and grease by scraping and using a stiff brush with solvent. Dry with compressed air.

RG,RG34710,2111 –19–15MAR97–1/1

Separate Housing

1. Remove four through bolts (A).

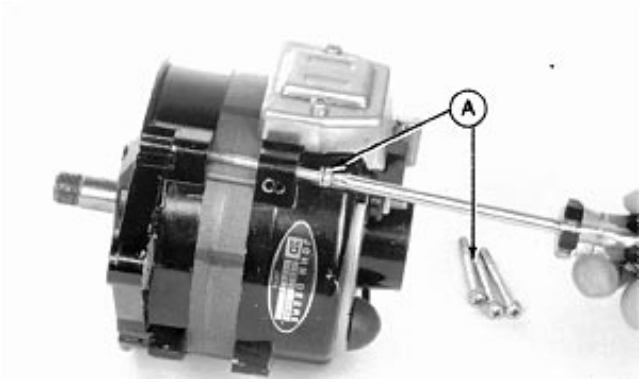
NOTE: Pulley need not be removed at this time. See REMOVE PULLEY NUT in this group if only pulley service is required.

IMPORTANT: Inserting screwdriver blade farther than 1.6 mm (1/16 in.) may damage stator windings.

2. Separate front and rear housings. Carefully pry between the two end frames with a screwdriver on each side.

3. If housings separate, set alternator on rear housing and slide off from housing; go to INSPECT REAR BEARING, later in this group.

4. In some cases, removing the rotor and rear bearing may be difficult. A vacuum may be created in the bearing cavity as the bearing and rotor are removed. If this happens, see SEPARATE HOUSING AND REMOVE REAR BEARING, later in this group.



Remove Through Bolts

A—Through Bolts (4 Used)

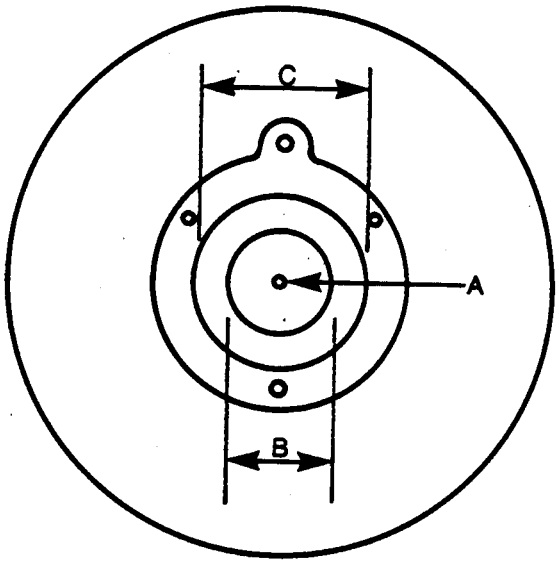
RG,RG34710,2112 –19–15MAR97–1/1

Separate Housing and Remove Rear Bearing

IMPORTANT: Mark must be centered to prevent off-center drilling of rotor shaft if tapping is later required. (See step 3 below.)

1. Carefully center punch and drill a 2 mm (1/16 in.) hole (A) in the center of the rear housing. This will allow air into the bearing bore as bearing is removed.

A—Center Punch On Center
B—19 mm (0.741 in.)
C—28 mm (1.092 in.)



RW12623 –UN–10NOV88

Center Punch

25
10
5

Continued on next page

RG,RG34710,2113 –19–15MAR97–1/4

Again try to remove rotor and bearing. If rotor and bearing still cannot be removed, go to step 2. If bearing remains in end frame, do the following;

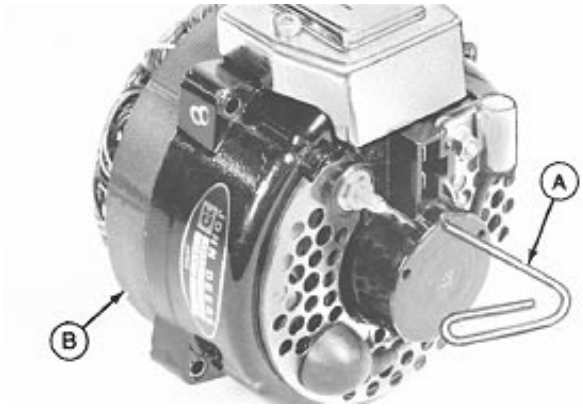
a. Install a pin (A) to hold brushes fully retracted.

b. Fill cavity behind bearing with grease through bearing bore. Place end frame on a hard, flat surface. Place a 12 mm (0.47 in.) screw or rod into bearing bore.

c. Strike end of screw or rod sharply with a hammer to hydraulically remove the bearing. Filling the cavity four to six times may be required to completely remove the bearing. Continue repairing alternator as detailed under INSPECT REAR BEARING later in this group.

2. Enlarge drilled hole with a 1/4 in. drill, 13 mm (1/2 in.) deep.

3. Measure length of a 1/16-27 NPT tap (JDG417, or equivalent) . Turn tap in hole until exposed end is 10—11 mm (0.390—0.430 in.) less than total length of tap.



RW6054 –UN–10NOV88

Remove Rotor and Bearing

A—Pin
B—Alternator

Continued on next page

RG,RG34710,2113 –19–15MAR97–2/4

4. Install a 1/16-27 NPT grease zerk (A) firmly in tapped hole.

5. Attach a grease gun to zerk and fill bearing cavity with grease. Extend handle of grease gun and apply several quick, pumping strokes until alternator frame and stator separate approximately 3—6 mm (1/8—1/4 in.)

IMPORTANT: Inserting screwdriver blade farther than 1.6 mm (1/16 in.) may damage stator windings.

6. Using two screwdrivers, complete alternator separation by prying between stator and front end frame.

7. Set alternator on rear housing and lift front housing.

1/16-27 NPT Grease Zerk

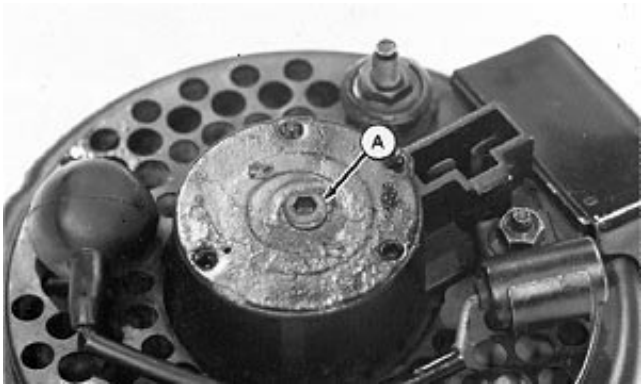
A—Grease Zerk

25
10
7

RG,RG34710,2113 –19–15MAR97–3/4

8. Remove grease zerk and install a 15H560 Allen plug (A) in drilled hole. If plug extends into bearing cavity more than 2 mm (1/6 in.), grind a tapper on end of plug and reinstall. Continue repairing alternator at INSPECT REAR BEARING, later in this group.

A—15H560 Allen Plug



15H560 Allen Plug

RG,RG34710,2113 –19–15MAR97–4/4

Inspect Rear Bearing

1. Check bearing ID and OD for damage.
2. Make sure bearing turns freely.

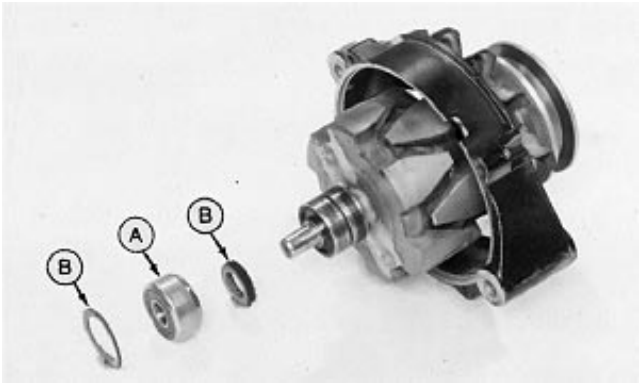
   Replace bearing as required.

RG,RG34710,2114 –19–15MAR97–1/1

Install Rear Bearing

IMPORTANT: Do not clean bearing in solvent.

1. Install a pin to hold brushes fully retracted. Clean grease and chips from bearing cavity.
2. Wipe bearing (A), bearing cavity and felt washers (B) with a clean cloth.
3. Coat bearing with a thin coat of grease to aid in installation of bearing in rear housing.
4. If a small hole 2 mm (1/16 in.) was drilled during disassembly, seal with a silicone sealer to prevent contaminant entry.



RW12629 –UN–10NOV88

Install Rear Bearing

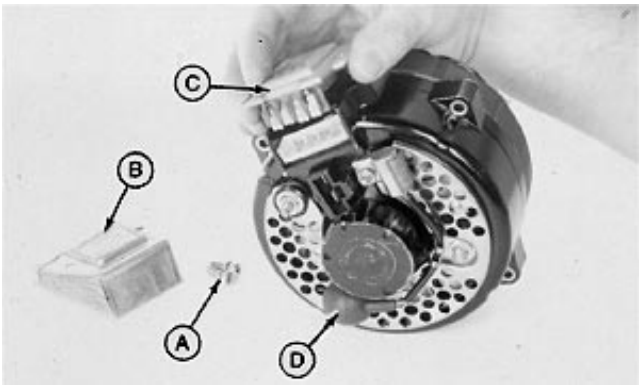
A—Bearing
B—Felt Washers

RG,RG34710,2115 –19–15MAR97–1/1

Remove Stator, Rectifier Bridge and Brush Assembly

1. Remove screws (A), regulator cover (B) and regulator (C).
2. Disconnect condenser wire (D) and remove condenser.

A—Screws
B—Regulator Cover
C—Regulator
D—Condenser Wire



RW10654 –UN–10NOV88

Regulator Components

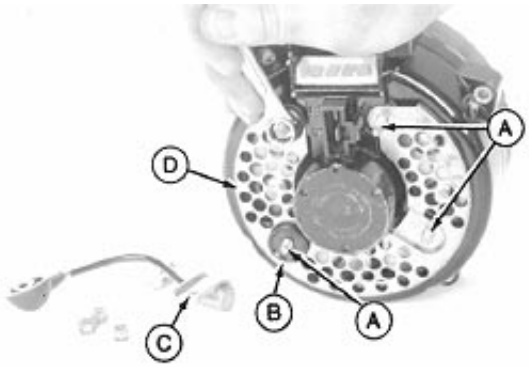
Continued on next page

RG,RG34710,2116 –19–15MAR97–1/2

3. Remove four nuts (A), insulators (B), condenser (C) and rear cover (D).

4. Lift out stator, rectifier bridge and brush assembly.

A—Nuts
B—Insulators
C—Condenser
D—Rear Cover



RW6043 –UN–10NOV88

Lift Out Parts

RG,RG34710,2116 –19–15MAR97–2/2

Test Brush Assembly

1. Inspect assembly for damage. Be sure brushes slide freely. Be sure springs hold brushes firmly against slip rings.

R78111K1 –UN–31JAN89

Inspect Brush Assembly

Continued on next page

RG,RG34710,2117 –19–15MAR97–1/3

2. Measure brushes for wear. If exposed length is not within specification, replace brushes.

Specification

Used Brushes—Minimum
Exposed Length..... 6 mm (0.25 in.)

R78111L1 –UN–31JAN89

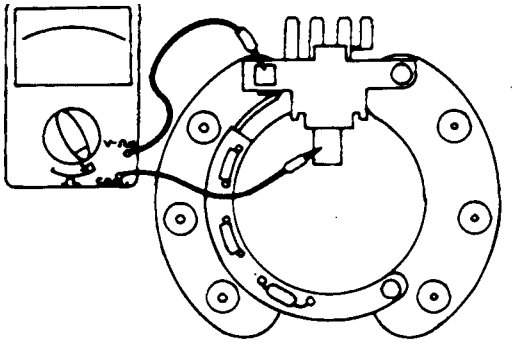
Measure Brushes for Wear

RG,RG34710,2117 –19–15MAR97–2/3

25
10
10

3. Connect ohmmeter (or test light) to check continuity between the two brushes and between each brush and ground. There should be no continuity.

   If brush holder is defective, rectifier bridge must be replaced.



R31565 –UN–31JAN89

Check Continuity

RG,RG34710,2117 –19–15MAR97–3/3

Install New Brushes

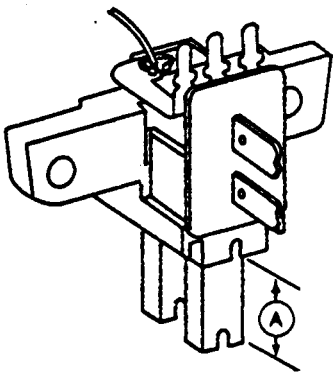
1. Install new brushes, blocking them in position so that exposed length (A) is within specification.

Specification

New Brushes—Exposed Length ..... 16 mm (0.625 in.)

2. Solder brush leads firmly in this position. Cut off excess length of leads.

A—Brush Exposed Length 16 mm (5/8 in.)



RW12624 –UN–10NOV88

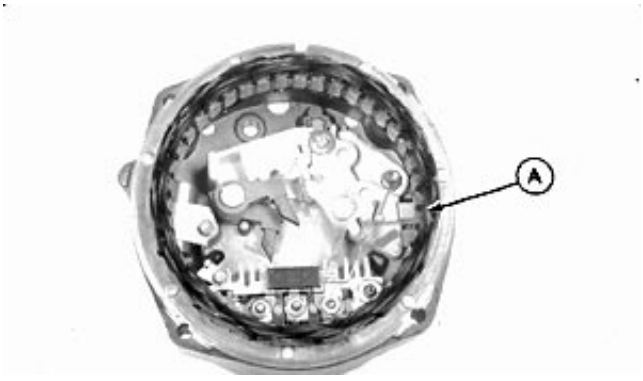
Exposed Brush Length

RG,RG34710,2118 –19–15MAR97–1/1

Inspect Stator

1. Inspect stator (A) for defective insulation.
2. Check for discoloration or a burned odor indicating a short circuit.
3. Replace stator if you find any defect.

A—Stator



RW6020 –UN–10NOV88

Inspect Stator

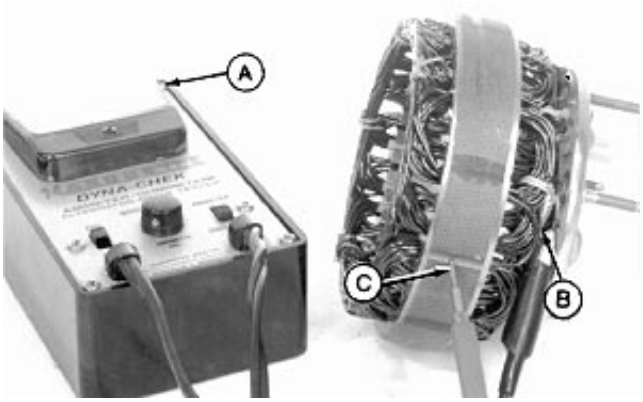
RG,RG34710,2119 –19–15MAR97–1/1

25
10
11

Test Stator for Grounds

1. Connect ohmmeter (A) (or test lamp) to stator lead (B) and stator frame (C).
2. Repeat test for each stator lead.
3. If test shows continuity, replace stator.

A—Ohmmeter
B—Stator Lead
C—Stator Frame



Test Stator for Grounds

RG,RG34710,2120 –19–15MAR97–1/1

25
10
12

Test Stator for Open or Short

NOTE: Stator cannot be tested for open circuit unless windings are disconnected.

A stator will occasionally exhibit an open or short circuit only when hot, making the defect even more difficult to diagnose.

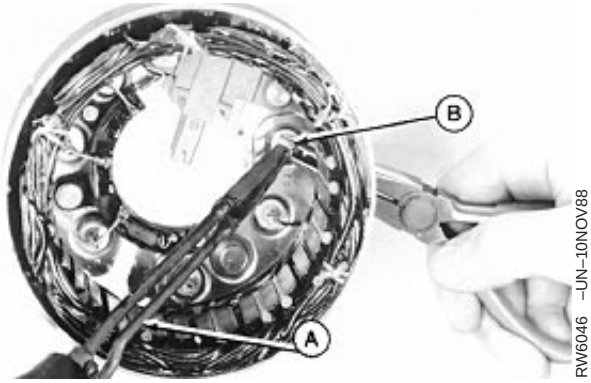
If a defective stator is suspected, but cannot be confirmed, recheck all other electrical components. If a problem is not found elsewhere, replace stator.

RG,RG34710,2121 –19–15MAR97–1/1

Test Diodes in Rectifier Bridge

NOTE: Stator must be disconnected from rectifier bridge to test diodes. Test diodes only if diagnostic tests indicate defective diodes.

1. Use a soldering iron (A) of at least 120-watt capacity.
2. Grasp diode connector (B) with needle-nose pliers to serve as heat sink and to protect diode from overheating.
3. Work quickly to disconnect.



Test Diodes in Rectifier Bridge

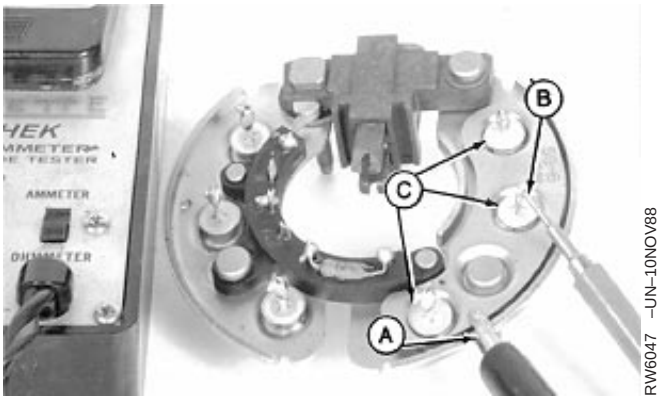
A—Soldering Iron
B—Diode Connector

RG,RG34710,2122 –19–15MAR97–1/1

Test Diodes for Open or Short Circuit

1. Connect one ohmmeter probe (A) to metal base.
2. With other ohmmeter probe (B), touch each of three diodes (C). Note ohmmeter readings.

A—Ohmmeter Probe
B—Ohmmeter Probe
C—Diodes



Test Diodes for Open or Short Circuit

25
10
13

Continued on next page

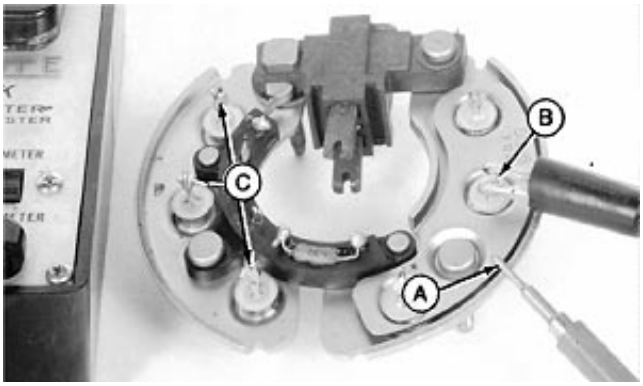
RG,RG34710,2123 –19–15MAR97–1/2

3. Reverse ohmmeter probes (A and B) and make the same checks. Note ohmmeter readings.

4. Perform steps 1 through 3 on diodes (C) on the opposite side of rectifier bridge.

   Ohmmeter readings should indicate that each diode has continuity in only one direction. A shorted diode would have continuity in both directions. An open diode would not have continuity in either direction.

A—Ohmmeter Probe
B—Ohmmeter Probe
C—Diodes



Reverse Check

RG,RG34710,2123 –19–15MAR97–2/2

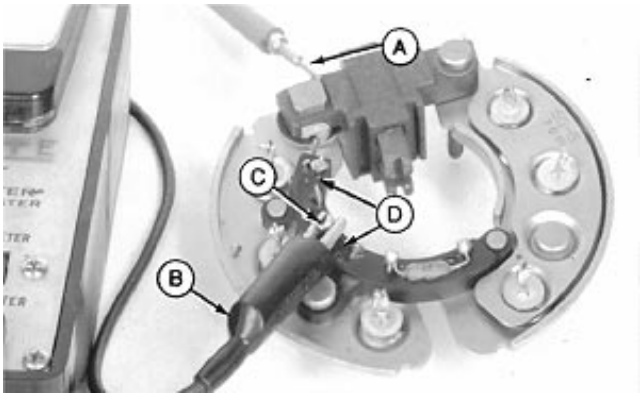
25
10
14

Test Diode/Resistor Trio

1. Touch one ohmmeter probe (A) against terminal “G”. Touch other ohmmeter probe (B) to the NEARER terminal (C) (the terminal that would be connected to stator windings) of each of the two diodes (D). Note ohmmeter readings.

2. Reverse ohmmeter probe.

   Each diode should have continuity in only one direction. If either diode is defective, rectifier bridge must be replaced.



Test Diode/Resistor Trio

A—Ohmmeter Probe
B—Ohmmeter Probe
C—Stator Winding Terminal
D—Diodes

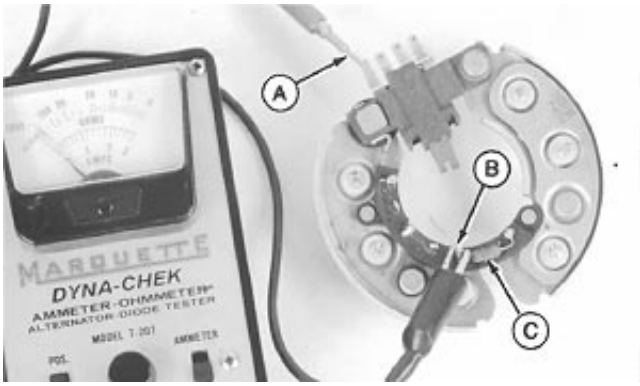
Continued on next page

RG,RG34710,2124 –19–15MAR97–1/2

3. Place one ohmmeter probe (A) against terminal “G”. Touch probe (B) to NEARER terminal of resistor (C).

4. Resistance should be about 100 ohms. If resistor is defective, replace rectifier bridge.

A—Ohmmeter Probe
B—Ohmmeter Probe
C—Resistor Terminal



RW6050 –UN–10NOV88

Check Resistor

RG,RG34710,2124 –19–15MAR97–2/2

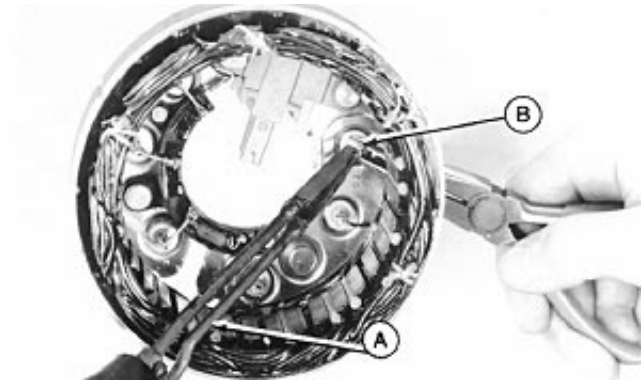
Connect Stator Windings

1. Use a soldering iron (A) with 120-watt capacity.

2. Grasp diode connector (B) with needle-nose pliers to act as heat sink.

3. Connect triple leads of stator winding to side of rectifier bridge. Connect each triple lead to both a rectifier diode and the diode/resistor trio.

4. Solder all nine connections quickly to prevent overheating. Use rosin-core solder only.



RW6046 –UN–10NOV88

Connect Stator Windings

A—Soldering Iron
B—Diode Connector

RG,RG34710,2125 –19–15MAR97–1/1

Test Regulator

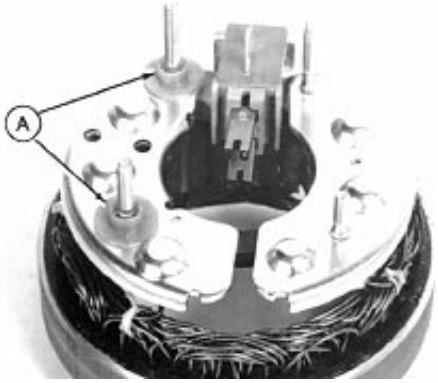
The only suitable way to test a regulator is to install it on an alternator known to be good and measure regulator output voltage. Normal regulator voltage is 13.8—14.8 volts. Replace regulator if voltage is too high or too low.

RG,RG34710,2126 –19–15MAR97–1/1

Assemble Rear Frame

1. Place insulating bushings (A) on two screws on output side of rectifier bridge.

A—Insulating Bushings



RW6051 –UN–10NOV88

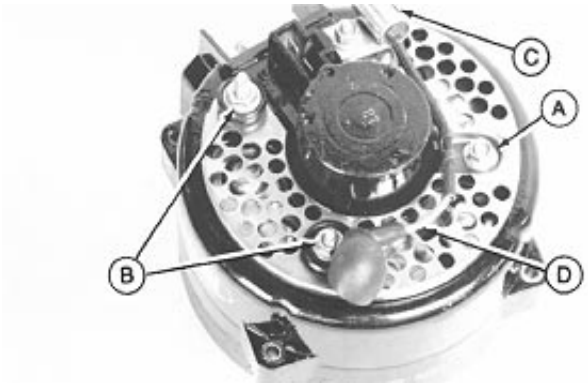
Insulating Bushings

RG,RG34710,2127 –19–15MAR97–1/2

25
10
16

2. Install rectifier bridge/stator in rear housing.
3. Install rear cover (A).
4. Install insulator bushings (B).
5. Install condenser (C) and attach condenser wire (D).

A—Rear Cover
B—Insulator Bushings
C—Condenser
D—Condenser Wire



RW6052 –UN–10NOV88

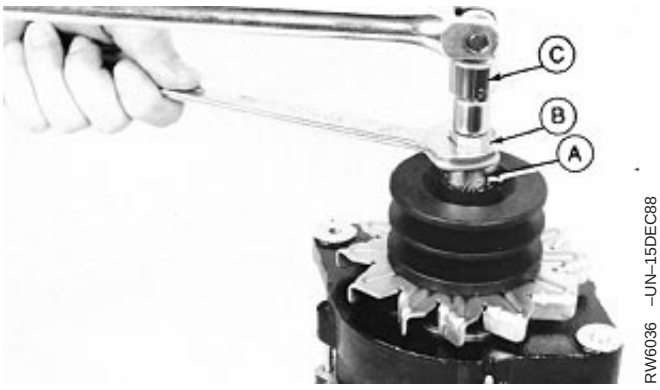
Install Parts

RG,RG34710,2127 –19–15MAR97–2/2

Remove Pulley Nut

NOTE: Pulley nut need not be removed if you are certain that front bearing is in good condition. Separate housing as described earlier in this group and leave rotor in front housing.

1. Install a 22 mm socket (A) on JD306A-1 Tool (B) (from JD306A Alternator Pulley Nut Tool Set) to hold nut.
2. Install JD306A-2 (C) on hex shaft of JD306A-1 to hold rotor shaft.
3. Hold rotor and remove nut, pulley and fan.



RW6036 –UN–15DEC88

Remove Pulley Nut

A—22 mm Socket
B—JD306A-1 Tool
C—JD306A-2 Tool

RG,RG34710,2128 –19–15MAR97–1/1

Remove and Inspect Front Bearing

1. Remove three screws (A) holding bearing retainer to front housing.

A—Screws (3 Used)

RW6038 –UN–10NOV88

Remove Screws

Continued on next page

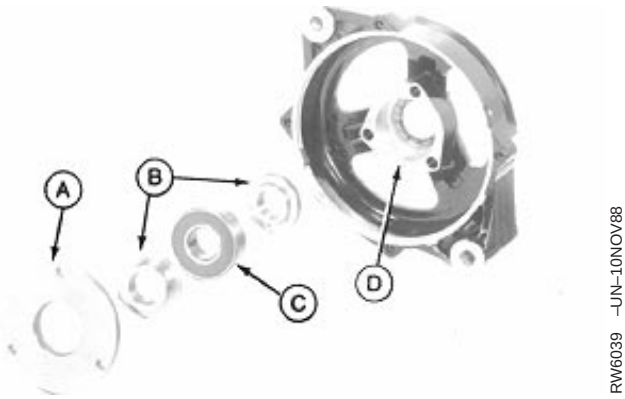
RG,RG34710,2129 –19–15MAR97–1/2

2. Remove bearing retainer (A), collars (B) and bearing (C).

3. Inspect bearing and bearing bore (D) for damage. Bearing may be reused, if not damaged.

4. Inspect collars (B) and felt washers on collars. Also inspect O-ring on bearing retainer.

A—Bearing Retainer
B—Collars
C—Bearing
D—Bearing Bore



RW6039 –UN–10NOV88

Inspect Parts for Damage

RG,RG34710,2129 –19–15MAR97–2/2

25
10
18

Install Front Bearing Assembly

1. Wipe bearing, bearing cavity, collars and felt washers with a clean cloth.

2. Coat bearing with a thin film of grease to aid installation of bearing in housing.

3. Install bearing assembly.

RG,RG34710,2130 –19–15MAR97–1/1

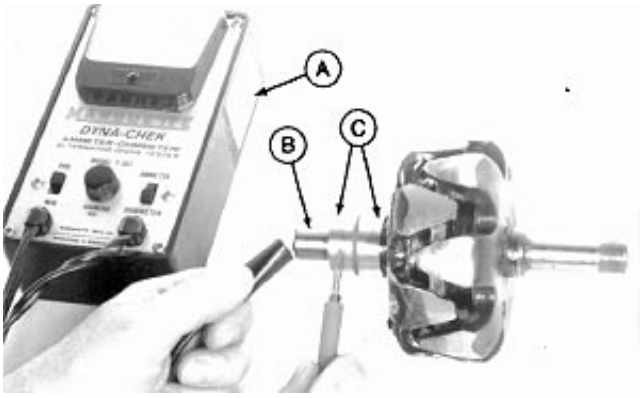
Test Rotor for Grounds

1. Use an ohmmeter (A) or test lamp to test for continuity.

2. Attach ohmmeter to rotor shaft (B) and each slip ring (C).

3. Replace rotor if test shows continuity.

A—Ohmmeter
B—Rotor Shaft
C—Slip Rings



RW6017 –UN–10NOV88

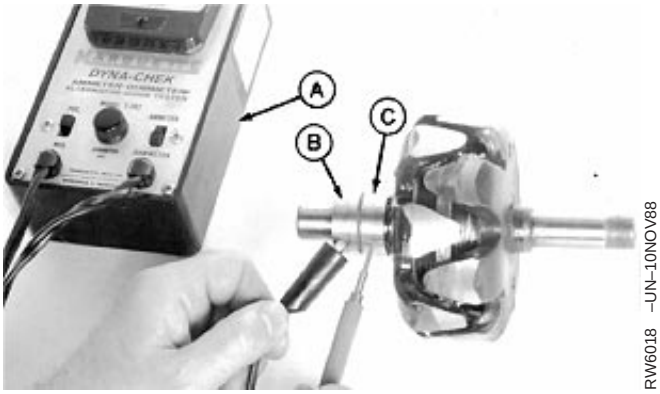
Test Rotor for Grounds

RG,RG34710,2131 –19–15MAR97–1/1

Test Rotor for Open or Shorted Circuits

1. Connect ohmmeter (A) to each slip ring (B and C) to measure resistance.
2. Resistance should be 3—5 ohms. Replace rotor if resistance is too high or too low.

A—Ohmmeter
B—Slip Ring
C—Slip Ring



Measure Resistance

RG,RG34710,2132 –19–15MAR97–1/1

Recondition Slip Rings

25
10
19

NOTE: Rough or out-of-round slip rings can cause short brush life.

1. Mount rotor assembly on lathe.
2. If slip rings are rough or scored, turn them just enough to eliminate roughness. If slip rings are out-of-round, turn them to within 0.05 mm (0.002 in.) of total indicator reading.
3. Polish slip rings sparingly with No. 00 sandpaper or 400-grit silicon carbide paper.

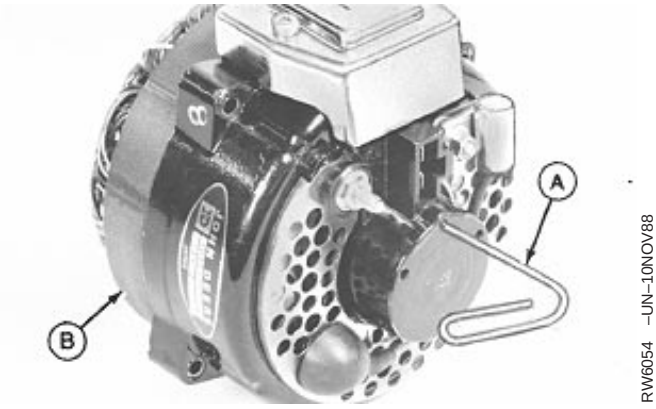
IMPORTANT: Clean rotor and stator with compressed air only. Cleaning solvent will damage insulation.

RG,RG34710,2133 –19–15MAR97–1/1

Install Rotor and Front Housing

1. Push back brushes to clear rear bearing.
2. Insert pin (A) through hole in rear housing to hold brushes fully retracted.
3. Place felt washer on rear bearing end of rotor shaft, install rotor in rear housing (B) and remove wire. Be sure brushes have good contact with rotor slip rings.

A—Pin
B—Rear Housing



RW6054 –UN–10NOV88

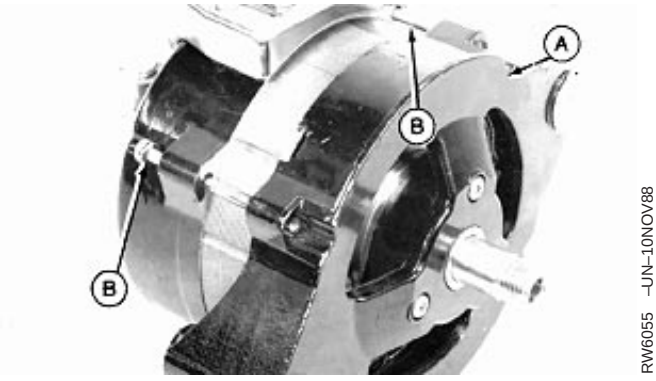
Install Rotor and Front Housing

RG,RG34710,2134 –19–15MAR97–1/2

25
10
20

4. Slide front housing (A) onto rotor shaft and secure with four through bolts (B). Rotate rotor to ensure that it is free from any interferences.

A—Front Housing
B—Through Bolts (4 Used)



RW6055 –UN–10NOV88

Secure Front Housing

RG,RG34710,2134 –19–15MAR97–2/2

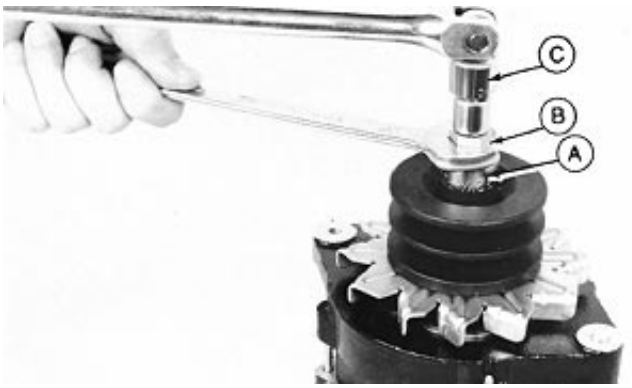
Install Pulley Assembly

Install fan, pulley, washer and pulley nut. Tighten pulley nut to specifications using JD306A Alternator Pulley Nut Tool.

Specification

Pulley Nut—Torque ..... 66—87 N•m (50—65 lb-ft)

1. Install a 22 mm socket (A) on JD306A-1 (B) to hold nut.
2. Install JD306A-2 (C) on hex shaft of JD306A-1 to hold rotor shaft.
3. Hold rotor shaft and tighten nut to torque above.



RW6036 –UN–15DEC88

Install Pulley Assembly

A—22 mm Socket
B—JD306A-1 Tool
C—JD306A-2 Tool

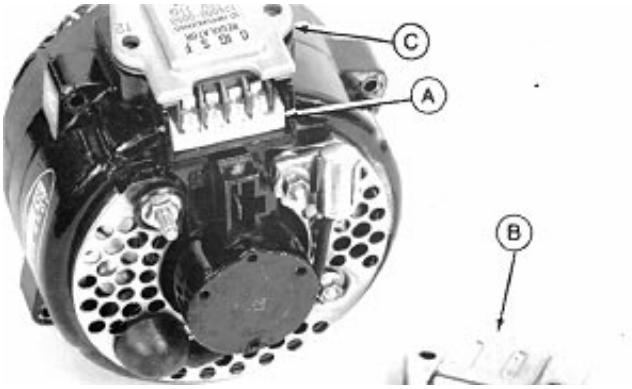
RG,RG34710,2135 –19–15MAR97–1/1

Install Regulator

1. Slip insulator (A) over regulator terminals. Slip it back into notches at base of terminals.
2. Attach regulator (B) and cover (C).

   Refer to your machine technical manual for alternator installation and correct V-belt adjustments.

A—Insulator
B—Regulator
C—Cover



RW6053 –UN–10NOV88

Install Regulator

RG,RG34710,2136 –19–15MAR97–1/1

25
10
21

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B78 –19–08MAY02–1/5

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

25
15
1

OUO1004,0000B78 –19–08MAY02–2/5

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000B78 –19–08MAY02–3/5

Alternator Pulley Tool Set JD306A

Remove and install alternator pulley retaining nut.

RG12198 –UN–17JUL02

JD306A

Continued on next page

OUO1004,0000B78 –19–08MAY02–4/5

Alternator Pulley Tool Set JDG672

Remove and install alternator pulley retaining nut on 12-volt, 120-amp Denso alternator.

RG5495 –UN–09JAN90

JDG672

OUO1004,0000B78 –19–08MAY02–5/5

25
15
2

Other Material

Number	Name	Use
	400-Grit Silicon Carbide Paper or 00 Sandpaper	Polish slip rings.
	Chevron SR1-2 Grease	Lubricate alternator bearing

OUO1004,0000B7A –19–21SEP00–1/1

Denso Charging Circuit Repair Specifications (Alternators with Built-In Regulator)

Item	Measurement	Specification
New Brush	Exposed Length	10.5 mm (0.40 in.)
Used Brush	Minimum Exposed Length	4.5 mm (0.18 in.)
Rotor Slip Ring	OD	14.0—14.4 mm (0.55—0.57 in.)
Rear End Cover	Torque	4.5 N•m (40 lb-in.)
Drive End-to-Rear End Frame	Torque	4.5 N•m (40 lb-in.)
IC Regulator	Torque	2.0 N•m (18 lb-in.)
Brush Assembly	Torque	2.0 N•m (18 lb-in.)
Rectifier Terminal	Torque	6.5 N•m (57 lb-in.)
Pulley Nut	Torque	94—127 N•m (70—95 lb-ft)

OUO1004,0000BB3 –19–28SEP00–1/1

Denso Charging Circuit Test Specifications (Alternators with Built-In Regulator)

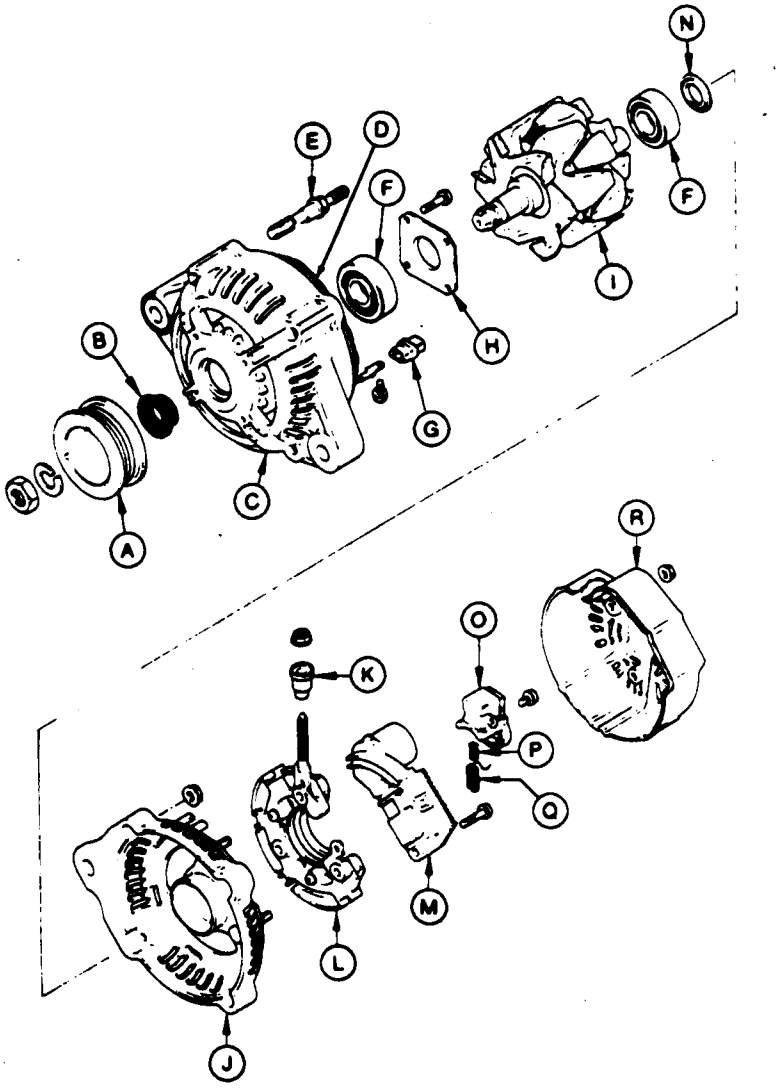
John Deere Alternator Part No.	Denso Alternator Part No.	Voltage	Rated Output (Amps)
CH10493	021000—7281	12	25
RE34888	100211—5030	12	90
RE34890	100211—7130	12	120
RE37201	100211—6031	12	120
RE42123	100211—6030	12	120
RE42778	100211—4200	12	40
RE44140	100311—6050	12	120
RE46043	100211—2470	12	60
RE46608	100211—6420	12	140
RE500226	101211—7780	12	140
RE500227	102211—1180	12	90
RE506145	101211—8620	12	60
RE51921	101211—6050	12	120
RE51922	100211—6040	12	120
RE60745	101211—7130	12	120
RE65414	102211—0040	24	60
RE70268	101211—133	12	40
RE71763	5—101211—148	12	65
RE72915		12	40
RE72916	101211—1131	12	40
RE72917	101211—2471	12	60
RE72918	102211—5121	12	65

Item	Specification
Regulator Output Voltage	13.9—15.1 volts

NOTE: Earlier Denso alternators may have the original Nippondenso label.

RG,RG34710,2139 –19–07JUL05–1/1

Disassemble and Test Denso Alternator with Built-In Regulator



Test Denso Alternator with Regulator

A—V-Ribbed Pulley
B—Spacer Collar
C—Drive End Frame
D—Stator
E—Stud Bolt
F—Bearing (2 Used)
G—Bushing
H—Retainer Plate
I—Rotor
J—Rear End Frame
K—"S" Terminal Insulator
L—Rectifier
M—IC Regulator
N—Bearing Cover
O—Brush Holder
P—Spring
Q—Brush
R—Rear End Cover

RG,RG34710,2140 –19–15MAR97–1/1

25
15
5

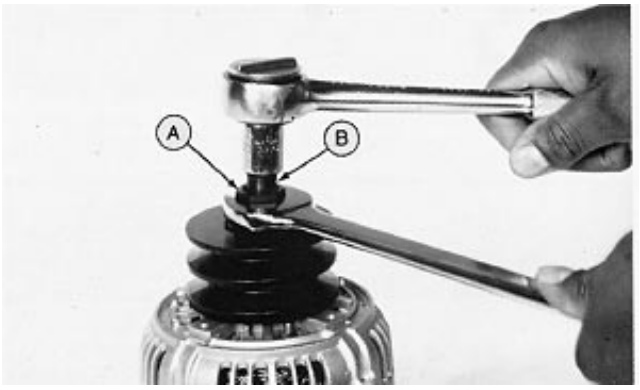
Disassemble Alternator

NOTE: Pulley nut need not be removed if you are sure that front bearing is in good condition. Separate housing as described and leave rotor in front housing.

Remove alternator pulley using JD306A Alternator Pulley Tool Set.

For 12-volt, 120-amp alternator, use JDG672 Alternator Pulley Tool Set as follows:

1. Install JDG672 Socket (A) on shaft nut. Hold socket using a 24 mm wrench as shown.
2. Install Snap-On SIMM100, 10 mm Impact Socket (B) onto rotor shaft hex.
3. Hold rotor shaft and remove nut and pulley.



Install Sockets

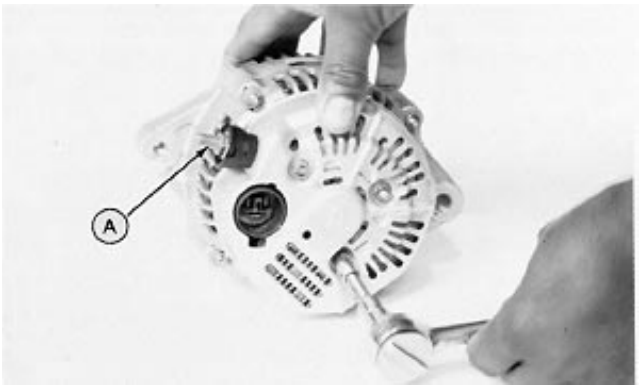
A—JDG672 Socket
B—Snap-On SIMM100, 10 mm Impact Socket

25
15
6

RG,RG34710,2141 –19–15MAR97–1/13

4. Remove nut and insulator from rectifier terminal (A).
5. Remove three nuts holding rear end cover to alternator assembly and remove cover.

A—Rectifier Terminal



Remove Nut from Rectifier Terminal

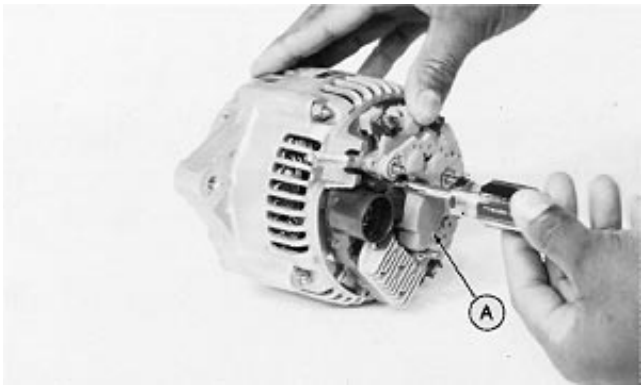
Continued on next page

RG,RG34710,2141 –19–15MAR97–2/13

6. Remove rubber boot (A) from brush assembly.

7. Remove two screws securing brush holder assembly to rectifier and remove brush holder assembly. Remove gasket from below brushes.

A—Rubber Boot



RG5483 –UN–09JAN90

Remove Rubber Boot

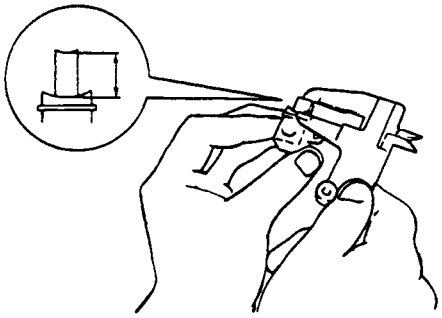
RG,RG34710,2141 –19–15MAR97–3/13

8. Measure length of brush protruding from the brush holder.

   Replace brush assembly if length is not within minimum serviceable length.

Specification

New Brush—Exposed Length	10.5 mm (0.40 in.)
Used Brush—Minimum Exposed Length	4.5 mm (0.18 in.)



RG5484 –UN–02MAR89

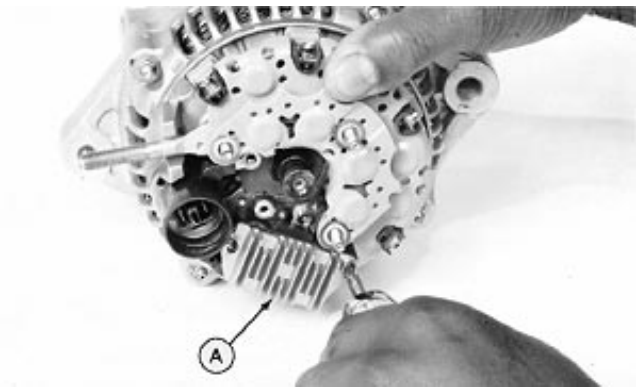
Measure Length of Brush

Continued on next page

RG,RG34710,2141 –19–15MAR97–4/13

9. Remove three screws securing IC regulator (A) to end frame and remove regulator.

A—IC Regulator



RG5485 –UN–09JAN90

Remove IC Regulator Screws

RG,RG34710,2141 –19–15MAR97–5/13

25
15
8

10. Disconnect four stator lead wires. Remove rectifier from alternator end frame.

11. Connect red lead of multimeter to output terminal (A) of rectifier. Connect stator attaching points (B) with the black lead of meter.

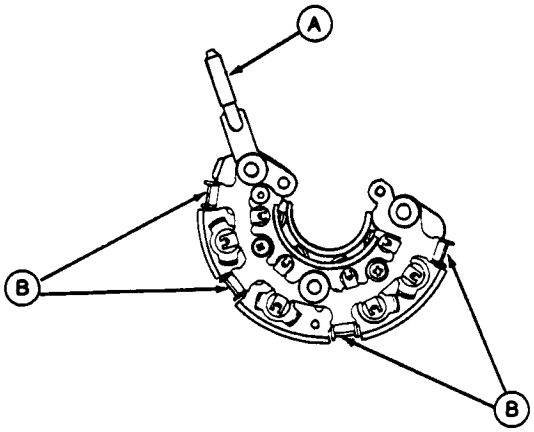
    There should not be continuity.

12. Reverse polarity of multimeter leads and repeat test outlined in step 11.

    There should be continuity.

    If there is continuity in both directions, diode is shorted. If no continuity in either direction, diode is open.

    If either diode is defective, rectifier bridge must be replaced.



RG5487 –UN–02MAR89

Check Continuity

A—Rectifier Output Terminal
B—Stator Attaching Points

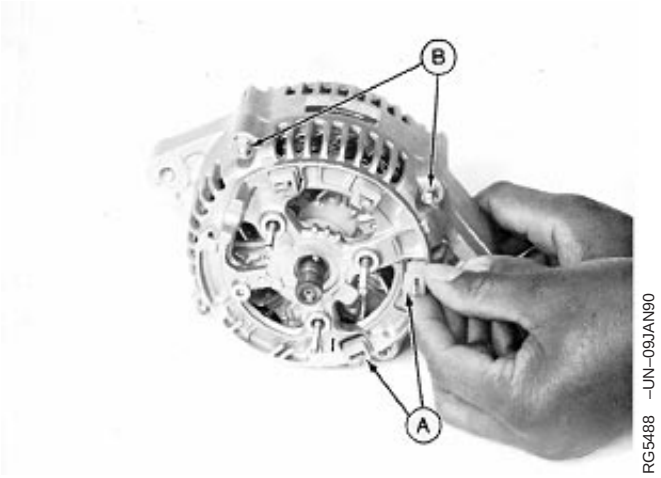
Continued on next page

RG,RG34710,2141 –19–15MAR97–6/13

13. Remove four rubber bushings (A) from stator leads. Do not stretch stator leads.

14. Remove four nuts (B) from stud bolts that hold drive and rear end frames together.

A—Rubber Bushings (4 Used)
B—Nuts (4 Used)



Remove Nuts and Bushings

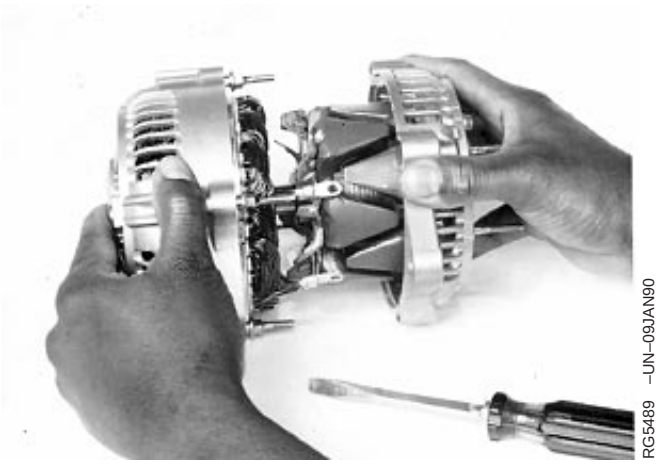
RG,RG34710,2141 –19–15MAR97–7/13

15. Carefully insert two flat screwdrivers in opposite openings between front and rear end housing.

IMPORTANT: DO NOT insert screwdriver blade more than 1.6 mm (1/16 in.). Damage to stator windings may result.

16. Apply prying pressure at several points to separate housings.

NOTE: If housings are difficult to separate, use a jaw-type puller to bear on rotor shaft and pull on rear end frame.



RG,RG34710,2141 –19–15MAR97–8/13

17. Remove rotor from housing by lightly tapping shaft (as shown) with a soft-faced hammer. Be careful not to drop rotor.

Continued on next page

RG,RG34710,2141 –19–15MAR97–9/13

18. Remove screws holding bearing retainer plate and remove plate. Drive bearing from housing. Remove bearing cover.

19. Install new bearing and bearing cover in housing bore. Install bearing retainer plate and tighten screws securely.

RG5491 –UN–09JAN90

RG,RG34710,2141 –19–15MAR97–10/13

20. Connect ohmmeter leads to each slip ring (as shown) to measure resistance.

    Resistance should be 2.0—4.0 ohms. Replace rotor if resistance is not within specification.

21. Connect black (—) lead of ohmmeter to end of shaft and the red (+) lead to each slip ring.

    There should be no continuity (0.1 ohm or less). Replace rotor if test shows continuity.

RG5492 –UN–09JAN90

RG,RG34710,2141 –19–15MAR97–11/13

22. Measure slip ring OD. Replace rotor if slip ring OD is below the acceptable limit.

Specification

Rotor Slip Ring—OD ..... 14.0—14.4 mm (0.55—0.57 in.)

23. If slip rings are rough or scored, turn them just enough to eliminate roughness. Polish sparingly with No. 00 sandpaper or 400-grit silicon carbide paper.

RG5493 –UN–09JAN90

Continued on next page

RG,RG34710,2141 –19–15MAR97–12/13

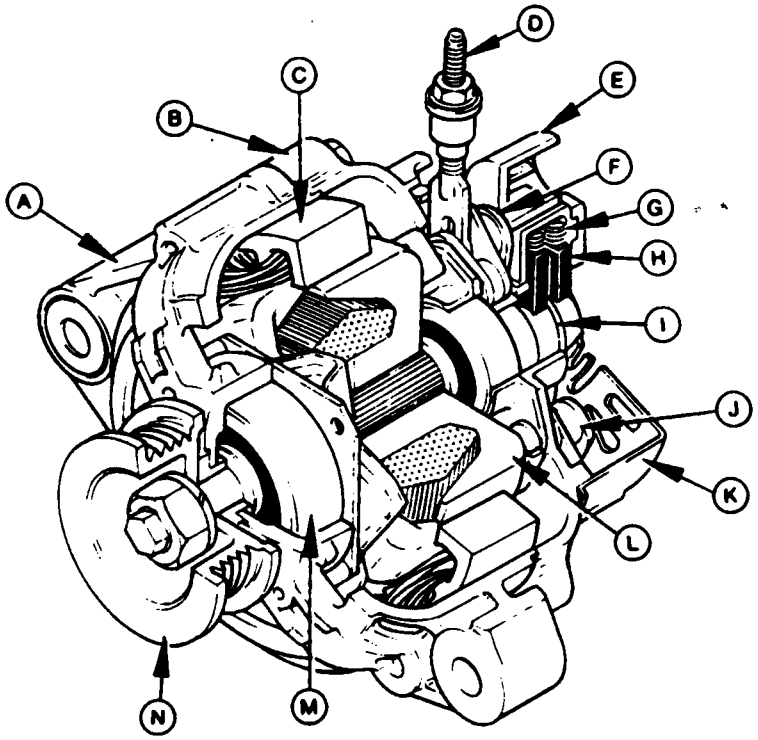
IMPORTANT: Clean rotor and stator with compressed air only. Cleaning solvent will damage insulation.

NOTE: Remove bearing only if replacement is necessary.

24. If necessary, remove bearing from rotor shaft using a puller as shown. If desired, rotor may be clamped in a soft-jawed vise.

RG,RG34710,2141 –19–15MAR97–13/13

Assemble Denso Alternator



RG5479 –UN–02FEB89

Assemble Denso Alternator

A—Driver End Frame
B—Rear End Frame
C—Stator Windings
D—"S" Terminal
E—Connector
F—IC Regulator
G—Spring
H—Brush
I—Slip Ring
J—Rectifier
K—Rear End Cover
L—Rotor
M—Bearing (2 Used)
N—Pulley

Assemble alternator in the reverse sequence of disassembly procedure while paying close attention to the following details:

1. If one bearing needs replacing, replace both bearings as a set. Lubricate bearings with grease.

2. Be sure screws securing IC regulator are in the correct position, so that too long of a screw will not touch rear end frame and cause battery overcharging.

3. Compress brush springs during assembly for clearance past slip rings.

4. Torque all hardware to specifications.

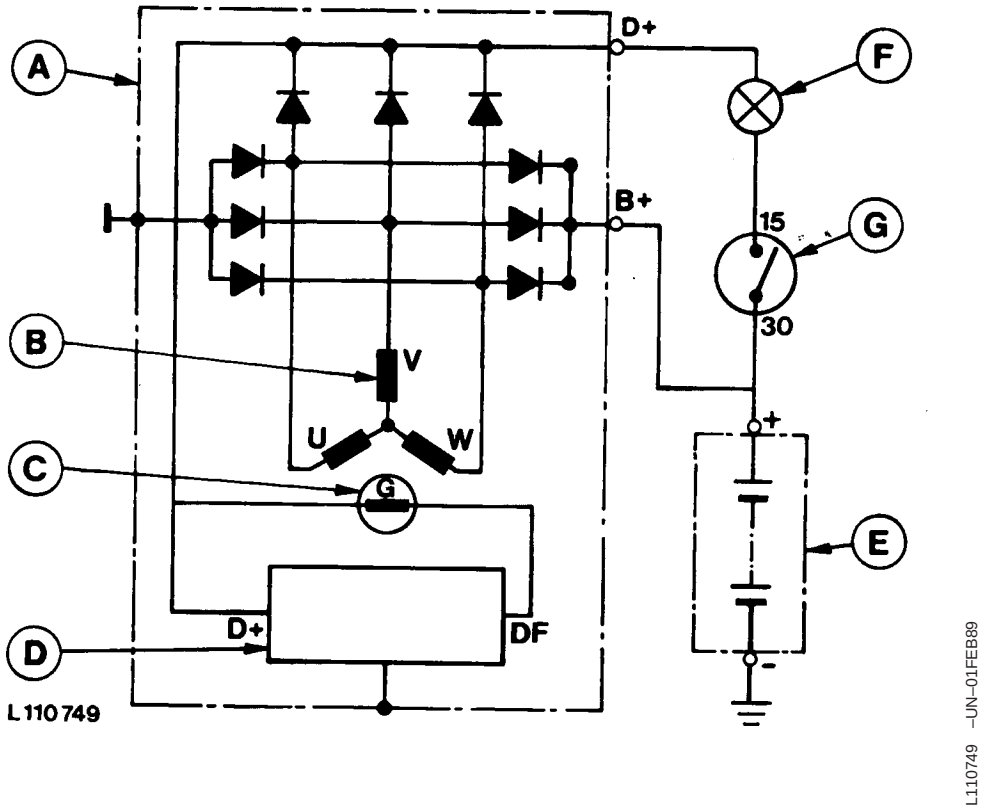
Specification	
Rear End Cover—Torque	4.5 N•m (40 lb-in.)
Drive End-to-Rear End Frame—Torque	4.5 N•m (40 lb-in.)
IC Regulator—Torque	2.0 N•m (18 lb-in.)
Brush Assembly—Torque	2.0 N•m (18 lb-in.)
Rectifier Terminal—Torque	6.5 N•m (57 lb-in.)
Pulley Nut—Torque	94—127 N•m (70—95 lb-ft)

RG,RG34710,2142 –19–15MAR97–1/1

Section 30
Bosch Alternators

Contents

Function of Alternator



Bosch 14-Volt Alternator

A—Alternator
B—Current Coil (Stator)
C—Exciting Coil (Rotor)
D—Regulator
E—Battery
F—Alternator Indicator Light
G—Starter Motor Switch

The Bosch 14-volt alternator is a 12-pole, self-induced synchronous generator. The current coil is located in the stator, and the exciting coil in the rotor. The exciting current is supplied by the rectifier (terminal D+) through the regulator, two carbon brushes and slip rings to the exciting coil in the rotor.

The alternator is normally driven by a fan belt from the engine crankshaft. The rotor is supported by two permanently lubricated bearings.

The alternator generates alternating current which is then transformed into direct current by the rectifier diodes.

The alternator windings are Y-connected. The coil ends U, V and W (see illustration) are connected to the rectifier diodes. The current flows through the diode and terminal B+ directly to the positive pole of the battery.

Alternator current is generated in each stator coil (B) of the alternator. During one revolution of the rotor (C), the voltage in the stator coil rises from 0 to the positive maximum, drops to 0, rises to the negative maximum and again drops to 0. Then the process is repeated.

As the stator coils are Y-connected, a three-phase or alternating current is generated. The individual phases are shifted 120°.

A sealed electronic regulator is used to regulate the alternator voltage. This regulator, which cannot be adjusted, limits the alternator voltage to approximately 14 volts.

RG,RG34710,2143 –19–15MAR97–1/1

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B7C –19–07JUL05–1/4

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUO1004,0000B7C –19–07JUL05–2/4

Alternator, Generator, Starter and Battery Bench Tester. JT01760

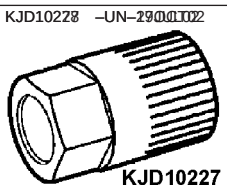
Test alternators and starters for voltage, resistance, or current flow.

Continued on next page

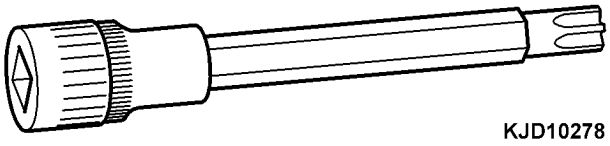
OUO1004,0000B7C –19–07JUL05–3/4

Alternator Pulley R & I Kit JDG1747

Used to remove and reinstall the Bosch alternator pulley on 6015, 6020, 7720, 7320, 7420 and 7520 Row Crop tractors. (Bosch 14V/90A, 14V/115A & 14V/150A). Individual tools in kit are: KJD10227 - Alternator Pulley Holding Adapter, KJD10278 - Alternator Pulley Tool and JDG1939 - Socket.



KJD10227



KJD10278

OUO1004,0000B7C –19–07JUL05–4/4

Other Material

Number	Name	Use
194891 (U.S.)	Delco-Remy High Temperature Bearing Grease	Apply to end frame bearing seat.

30
10
2

OUO1004,0000BBF –19–19OCT00–1/1

Bosch Charging Circuit Repair Specifications

Item	Measurement	Specification
Slip Rings	Maximum Radial Runout	0.03 mm (0.0012 in.)
Rotor Shaft	Maximum Radial Runout	0.05 mm (0.002 in.)
Slip Rings	Minimum Length	20 mm (0.79 in.)
Slip Rings	Minimum OD	26.8 mm (1.055 in.)
Used Brushes	Minimum Exposed Length	5 mm (0.2 in.)
New Brushes	Exposed Length	10 mm (0.4 in.)
Alternator Housing Cap Screws	Torque	4.0—5.5 N•m (33—48 lb-in.)
Armature	End Play	0.1—0.3 mm (0.004—0.012 in.)
Alternator Pulley Nut	Torque	35—45 N•m (25—32 lb-ft)

OUO1004,0000B7F –19–21SEP00–1/1

Bosch Charging Circuit Test Specifications

			Rating	
John Deere Alternator Part No.	**Bosch Alternator Part No.**	**Model/Series**	**Volts**	**Amps**
AE52707	9 120 060 042	K1	12(14)	120
AE53101	9 120 060 042, 0 120 484 017, 0 120 484 019	K1	12 (14)	120
AH137883	0 120 484 011	K1	12 (14)	95
AH165975	A 120 402 555	K1	12	120
AL111675	0 123 315 501	KC(R)	12 (14)	90
AL111676	0 123 512 500	NC(R)	12 (14)	115
AL119537	0 123 515 501	NC(R)	12 (14)	150
AL28516	0 120 489 704	K1	12 (14)	55
AL32141	0 120 339 512	G1	12 (14)	33
AL35998	0 120 489 704	K1	12	55
AL36100	0 120 339 545	G1	(14)	33
AL60033	0 120 484 003	K1	12	85
AL67175	0 120 488 218	K1	12 (14)	55
AL67176	0 120 402 425	K1	12	85
AL78689	0 120 488 267	K1	12 (14)	55
AL78690	0 120 484 016	K1	12 (14)	85
AL78692	0 120 484 017	K1	12 (14)	120
AL81436	0 120 488 290	K1	12 (14)	55
AL81437	0 120 484 020	K1	12 (14)	85
AL81438	0 120 488 019	K1	12 (14)	120
AR62401	0 120 300 535	G1	(14)	28
AT161324	0 120 488 206	K1	24 (28)	45
AT168711	0 120 468 136	N1	24 (28)	80
AT173624	0 120 488 205, 9 120 060 040	K1	12 (14)	65
AT175194	9 120 060 041	K1	12 (14)	95
AT175195	9 120 060 039	K1	24 (28)	45
AT175839	0 120 468 055	N1R	12 (14)	135
AT185696	F 005 A00022	K1	24	45
AT185951	F 005 A00025	K1	12	120
AT207608	F 005 A00003	K1	24	55
AT208541	0 120 468 136	N1	24	80
AT220393	F 005 A0 0023	K1	12	65
AT220394	F 005 A0 0024	K1	12	95
AT221116	F 005 A0 0003	K1	24 (28)	55
AT85458	0 122 469 004	N1	24 (28)	50

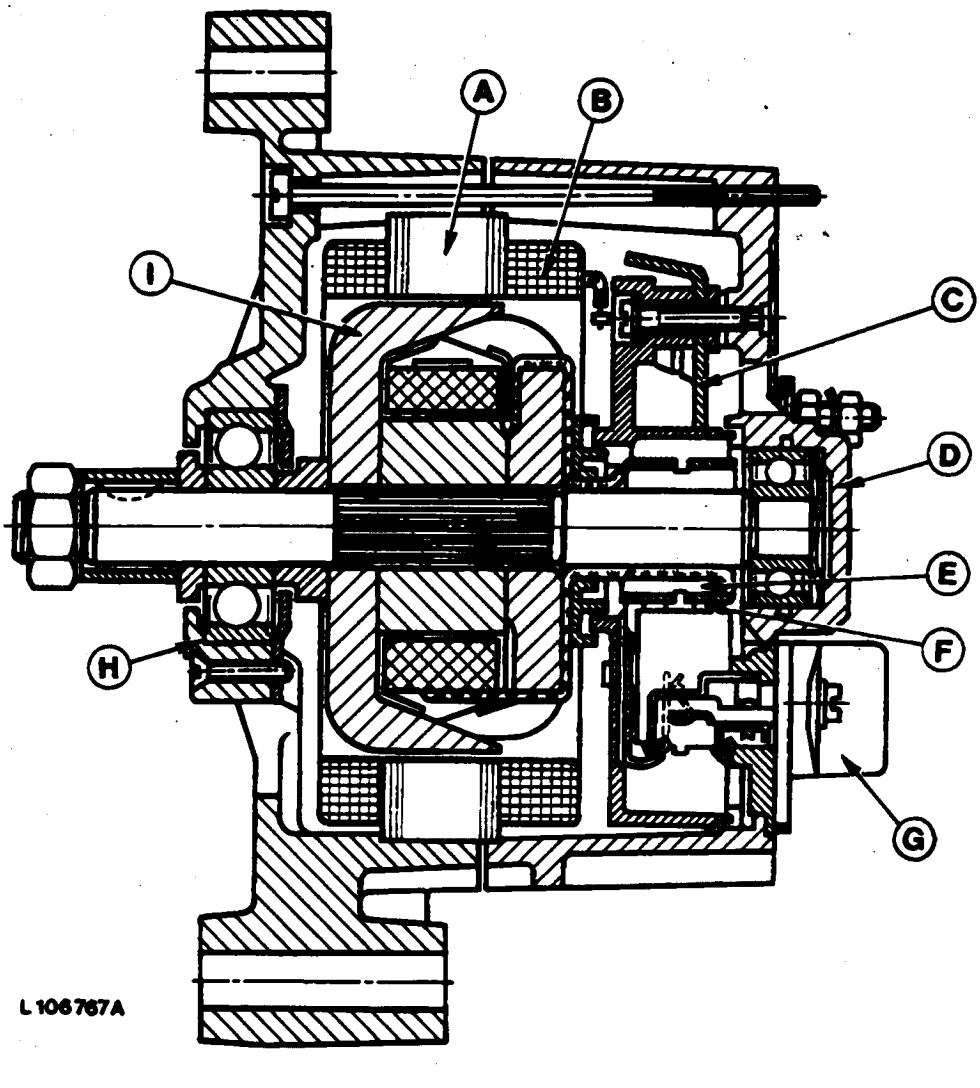
Continued on next page

			Rating	
John Deere Alternator Part No.	**Bosch Alternator Part No.**	**Model/Series**	**Volts**	**Amps**
AZ23575	0 120 339 512	G1	12 (14)	35
AZ31316	0 120 489 156	K1	12	65
AZ38462	0 120 484 012	K1	12 (14)	95
RE185213	0 123 515 5002		12 (14)	150
RE36267	0 120 484 011	K1	12 (14)	90
RE36268	0 120 468 055	N1	12 (14)	135
RE509648	0 124 0AB 5PB	K1	12 (14)	70

Item	**Specification**
Stator winding resistance	0.40—0.44 ohms
Rotor winding resistance	4.0—4.40 ohms

RG,RG34710,2145 –19–07JUL05–2/2

Alternator, Section View



Alternator, Section View

A—Stator Assembly
B—Stator Winding
C—Heat Sink
D—Bearing and End Frame
E—Slip Ring
F—Carbon Brush
G—Regulator
H—Bearing and Drive End Frame
I—Rotor

RG,RG34710,2146 –19–15MAR97–1/1

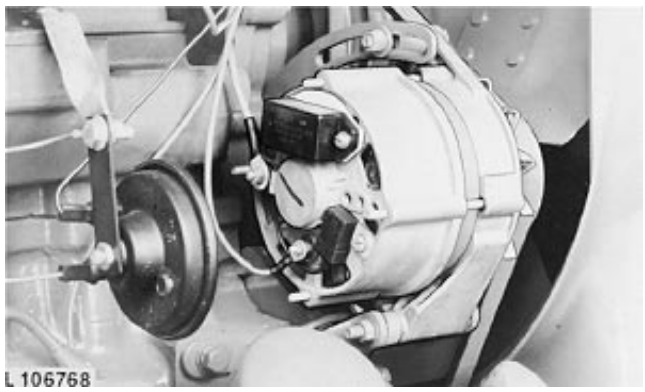
30
10
6

Alternator Removal

Disconnect ground straps of battery.

Disconnect cables from alternator.

Remove alternator per instructions in machine technical manual.

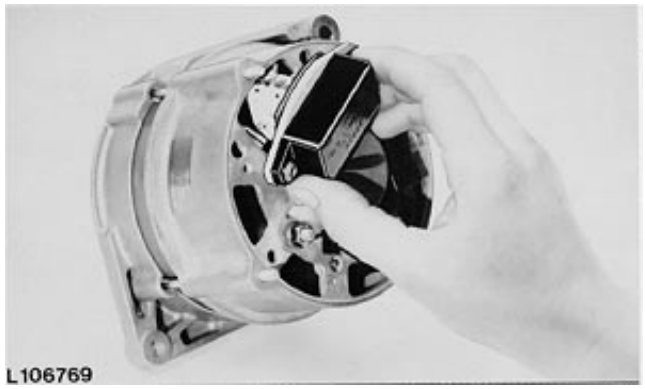


Alternator Removal

RG,RG34710,2147 –19–15MAR97–1/1

Removing Brush Holder with Regulator

NOTE: Before dismantling alternator, first remove brush holder with regulator so carbon brushes will not break during disassembly.



Remove Brush Holder with Regulator

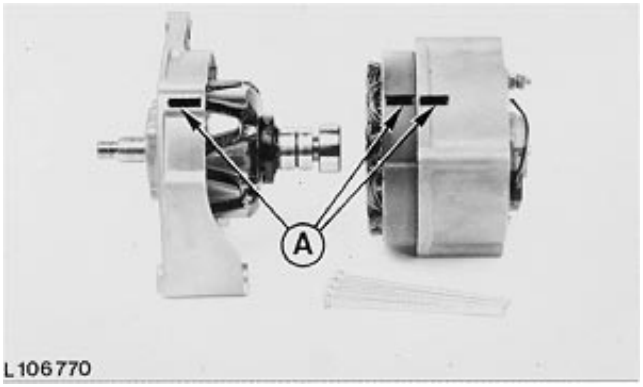
RG,RG34710,2148 –19–15MAR97–1/1

Alternator Disassembly

Mark position of both bearing end frames and stator for later assembly (A).

Press rotor out of drive end frame.

A—Position Marks



Mark End Frames and Stator

RG,RG34710,2149 –19–15MAR97–1/1

Stator Removal

Unsolder stator windings from diode leads of diode plate.

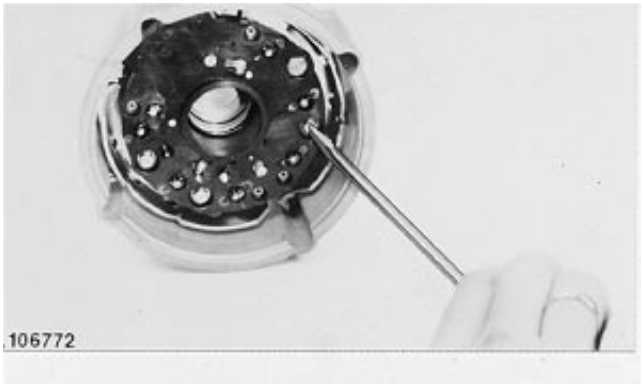
Unsolder Stator Windings

RG,RG34710,2150 –19–15MAR97–1/1

Diode Plate Removal

Remove screws from connections “D+” and “B+”.

Lift out diode plate.

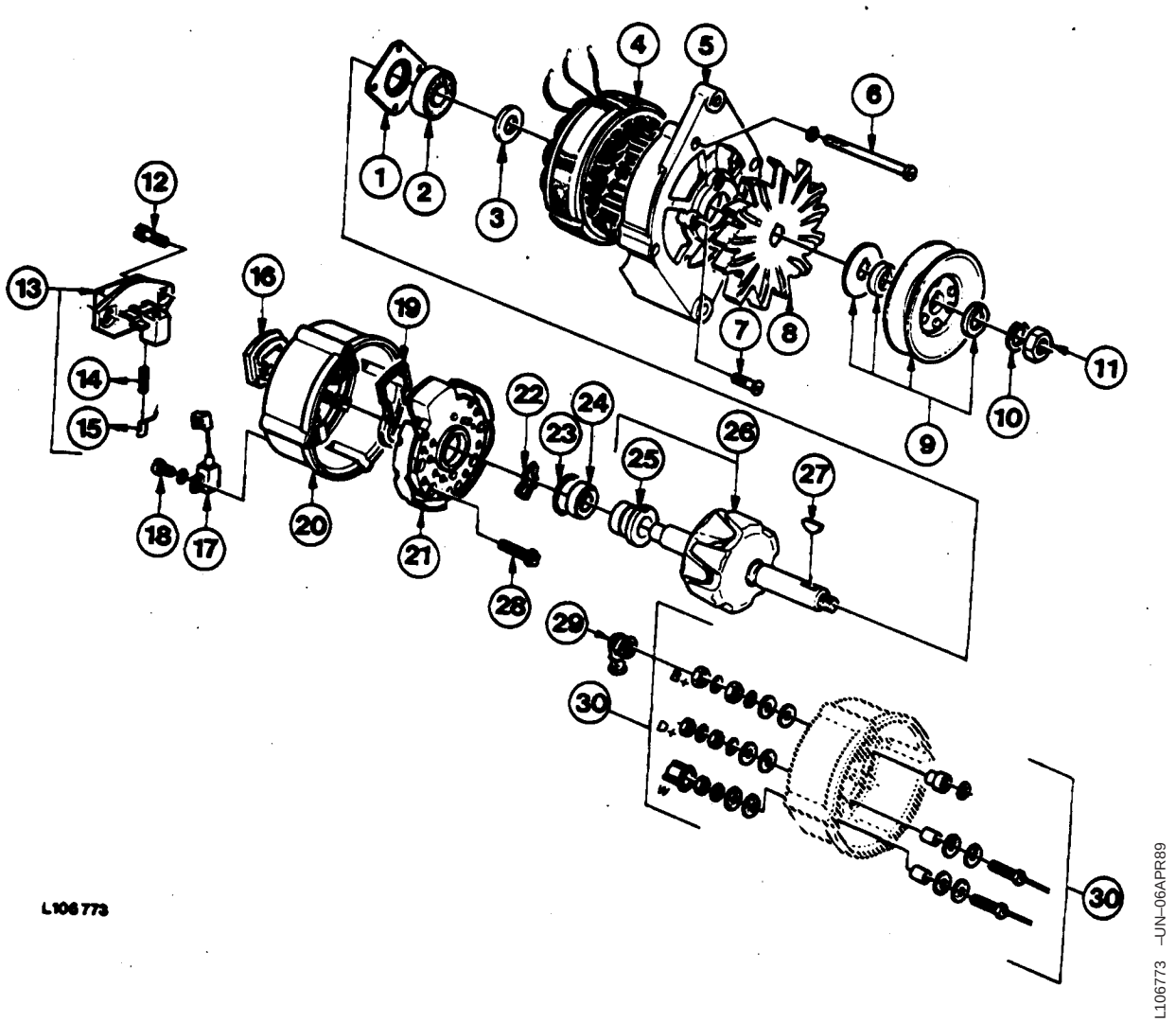


L106772 –UN–11JUL89

Diode Plate Removal

RG,RG34710,2151 –19–15MAR97–1/1

Alternator Exploded View



Alterator—Exploded View

1—Retaining Plate
2—Ball Bearing
3—Washer
4—Stator Coil
5—Drive End Frame
6—Cylinder Screw (4 Used)
7—Countersunk Screw (4 Used)[1]
8—Fan
9—Belt Pulley Repair Set
10—Snap Ring[1]
11—Hex Nut[1]
12—Screw with Spring Washer (2 Used)
13—Regulator with Brush Holder
14—Compression Spring (2 Used)
15—Carbon Brush (2 Used)
16—Gasket
17—Suppression Capacitor
18—Cylinder Screw
19—Gasket
20—End Frame
21—Diode Plate
22—Spring Washer[1]
23—O-Ring
24—Ball Bearing
25—Slip Ring
26—Rotor
27—Woodruff Key[1]
28—Screw with Spring Washer (3 Used)
29—Protective Cap
30—Repair Kit for Terminals W, D+ and B+

[1] Rotor Repair Kit.

RG,RG34710,2152 –19–15MAR97–1/1

Testing Rotor for Short Circuit

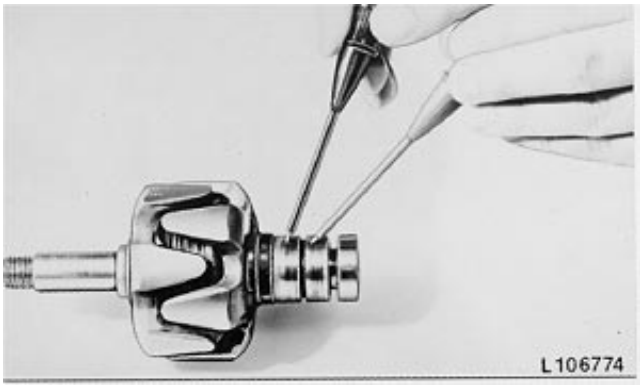
With a test lamp:

Test lamp must light brightly.

With an ohmmeter:

Ohmmeter indication must be between 4.0 and 4.4 ohms.

If test fails, replace rotor.



L106774 –UN–11JUL89

Test Rotor for Short Circuit

RG,RG34710,2153 –19–15MAR97–1/1

Testing Rotor for Ground

Use an ohmmeter to test for continuity.

Attach ohmmeter to rotor and each slip ring.

Replace rotor if test shows continuity.

L106775 –UN–11JUL89

Test Rotor for Ground

RG,RG34710,2154 –19–21SEP00–1/1

30
10
11

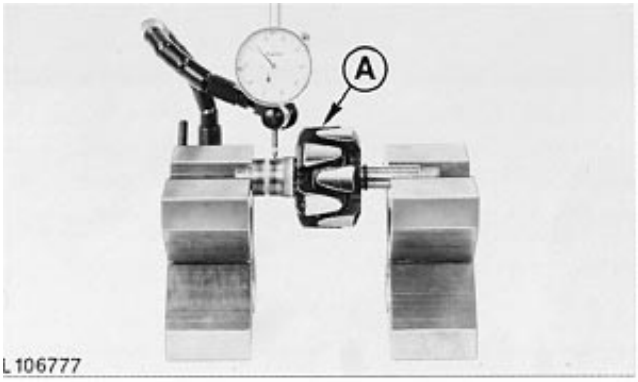
Testing Slip Rings and Rotor Shaft for Radial Runout

Check maximum radial runout of slip rings and rotor shaft.

Specification

Slip Rings—Maximum Radial Runout	0.03 mm (0.0012 in.)
Rotor Shaft—Maximum Radial Runout	0.05 mm (0.002 in.)

A—Rotor Shaft Test Point



L106777 –UN–11JUL89

Rotor Shaft Test Point

RG,RG34710,2155 –19–15MAR97–1/1

Turning Down Slip Rings

Turn down slip rings to length of only (A).

Specification

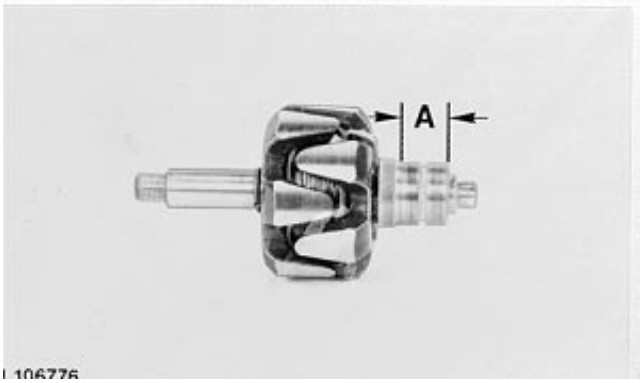
Slip Rings—Minimum Length	20 mm (0.79 in.)

Check diameter of slip rings.

Specification

Slip Rings—Minimum OD	26.8 mm (1.055 in.)

A—Slip Ring Length



L106776 –UN–11JUL89

Turning Down Slip Rings

RG,RG34710,2156 –19–15MAR97–1/1

Testing Stator Coil for Short Circuit

Test phase outlets with respect to each other as follows: A and B; B and C; A and C.

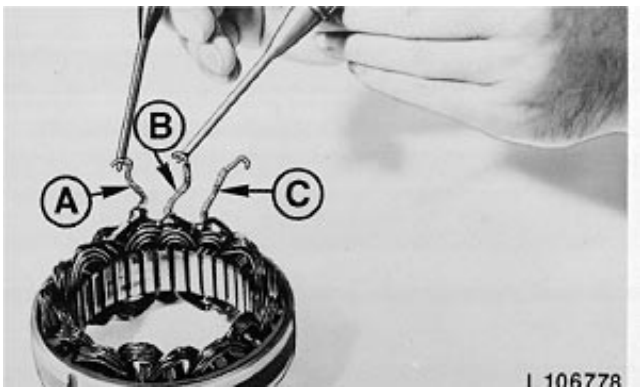
With test lamp:

Test lamp must light up brightly

With ohmmeter:

Indications between 0.40 and 0.44 ohms.

If test fails, replace stator coil.



L106778 –UN–11JUL89

Test Phase Outlets

A—Phase Outlet
B—Phase Outlet
C—Phase Outlet

RG,RG34710,2157 –19–15MAR97–1/1

Testing Stator Coil for Grounds

Connect ohmmeter (or test lamp) to stator lead and stator frame.

Repeat test for each stator lead.

If test shows continuity, replace stator.

L106779 –UN–11JUL89

Test Stator Coil for Grounds

RG,RG34710,2158 –19–15MAR97–1/1

Replacing Carbon Brushes

Replace carbon brushes if dimension (A) is less than specified.

Specification

Used Brushes—Minimum
Exposed Length..... 5 mm (0.2 in.)

NOTE: When soldering copper lead, make sure solder (rosin-core solder only) does not seep into the copper leads.

Solder new carbon brushes in such a way that dimension (A) does not exceed specifications.

Specification

New Brushes—Exposed Length ..... 10 mm (0.4 in.)

IMPORTANT: The service life of carbon brushes and ball bearings are matched to each other. Therefore, always replace ball bearings when renewing carbon brushes. Before installing new carbon brushes, slip rings must be checked and turned down if necessary.

L106780 –UN–11JUL89

Dimension

A—Carbon Brush Dimension

RG,RG34710,2159 –19–19OCT00–1/1

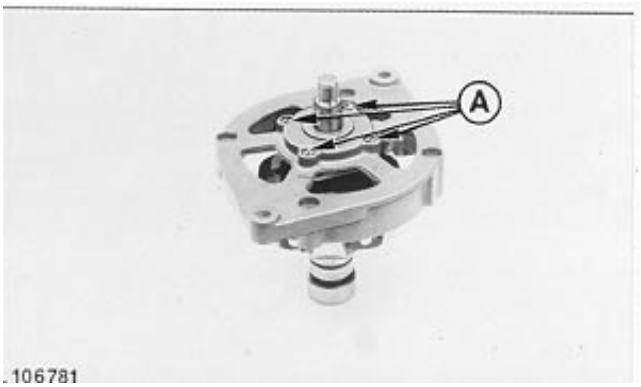
Replacing Ball Bearings

Remove attaching screws (A) of drive end frame retaining plate and force rotor out of drive end frame.

Pull off rotor ball bearing.

Removed ball bearings must be replaced.

A—Screws (4 Used)



L106781 –UN–11JUL89

Remove Attaching Screws

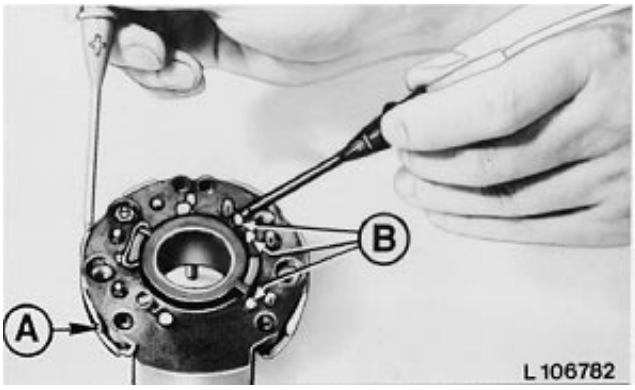
RG,RG34710,2160 –19–15MAR97–1/1

Checking Positive Diodes

Consecutively place positive test probe of ohmmeter to positive heat sink (A) and negative test probe to leads (B) of diodes.

Meter must not show continuity.

A—Positive Heat Sink
B—Diode Leads



L106782 –UN–11JUL89

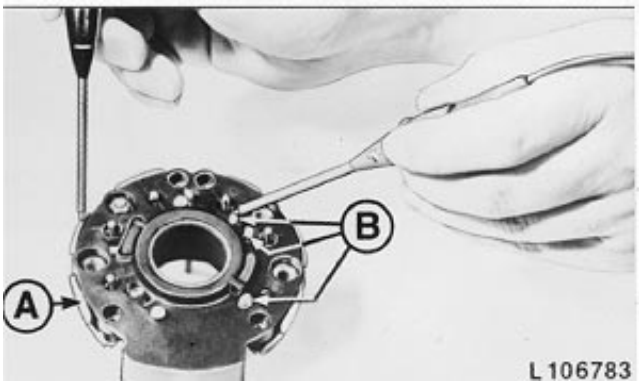
Check Positive Diodes

RG,RG34710,2161 –19–15MAR97–1/2

If no fault is found in the above described test, carry out this test with reversed polarity (see illustration).

Meter must show continuity.

NOTE: Test voltage 6—12 volts DC.



L106783 –UN–11JUL89

Reversed Polarity

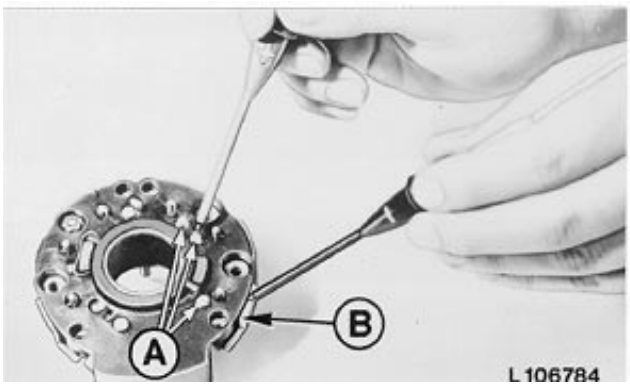
RG,RG34710,2161 –19–15MAR97–2/2

Checking Negative Diodes

Consecutively place positive test probe of ohmmeter to positive heat sink (B) and negative test probe to leads (A) of diodes.

Meter must not show continuity.

A—Diode Leads
B—Positive Heat Sink



L106784 –UN–11JUL89

Check Negative Diodes

RG,RG34710,2162 –19–15MAR97–1/2

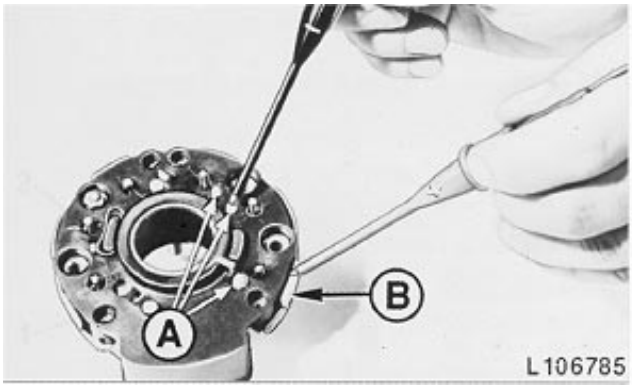
If no fault is found in the above described test, carry out this test with reversed polarity (see illustration).

Meter must show continuity.

NOTE: Test voltage 6—12 volts DC.

30
10
16

A—Diode Leads
B—Positive Heat Sink



L106785 –UN–11JUL89

Reverse Polarity

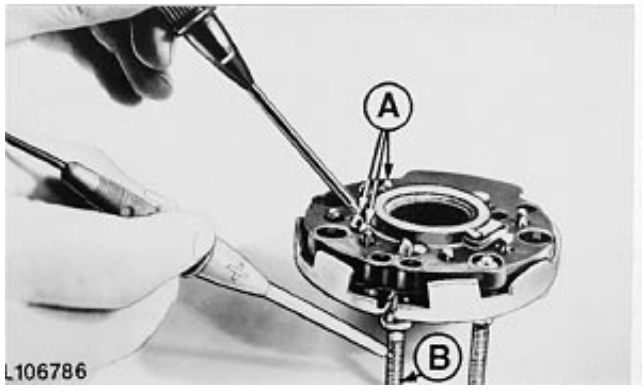
RG,RG34710,2162 –19–15MAR97–2/2

Testing Exciting Diodes

Place positive test probe of an ohmmeter on connection “D+” (B) and negative probe onto diode lead (A).

Meter must not show continuity.

A—Diode Leads
B—“D+” Connection



L106786 –UN–11JUL89

Test Exciting Diodes

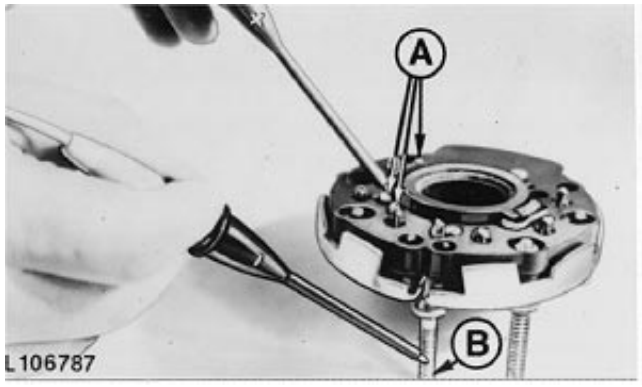
RG,RG34710,2163 –19–15MAR97–1/2

If no fault is found in the above described test, carry out this test with reversed polarity (see illustration).

Meter must show continuity.

NOTE: Test voltage 6—12 volts DC.

A—Diode Leads
B—“D+” Connection



L106787 –UN–11JUL89

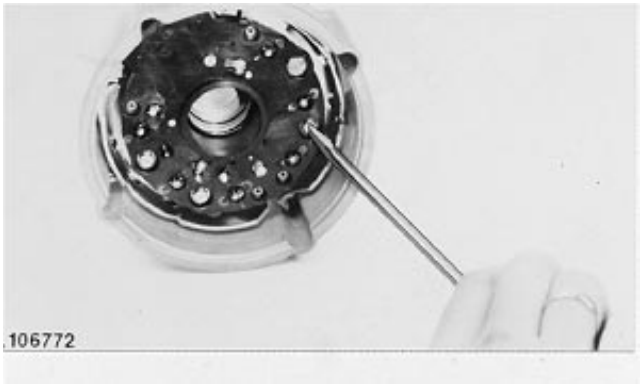
Reverse Polarity

RG,RG34710,2163 –19–15MAR97–2/2

Diode Plate Installation

Pay attention to perfect insulation connections “B+”, “D+” and the positive diode heat sink in respect to end frame.

Install diode plate as shown and tighten screws.



L106772 –UN–11JUL89

Install Diode Plate

RG,RG34710,2164 –19–15MAR97–1/1

Soldering Stator Coils

IMPORTANT: Use only rosin-core solder.

Make sure that no solder seeps inside diode plate.

Avoid overheating diodes.

L106771 –UN–11JUL89

Solder Stator Coils

RG,RG34710,2165 –19–15MAR97–1/1

Pressing Ball Bearing onto Rotor Shaft

For pressing on, use a sleeve which presses against the ball bearing inner race.

IMPORTANT: Never press onto drive end frame; damage may result.

Pressing Ball Bearing Onto Rotor Shaft

RG,RG34710,2166 –19–15MAR97–1/1

Pressing Rotor into Drive End Frame

Use a new retaining plate (A) when installing new ball bearing.

A—Retaining Plate

Retaining Plate

RG,RG34710,2167 –19–15MAR97–1/1

Assemble Alternator

Apply high temperature bearing grease such as Bosch FT70V1 or Delco Remy No. 194891 to end frame bearing seat. Place spring washer end in frame and carefully join both alternator halves, paying attention to markings.

Tighten screws (A) to specifications.

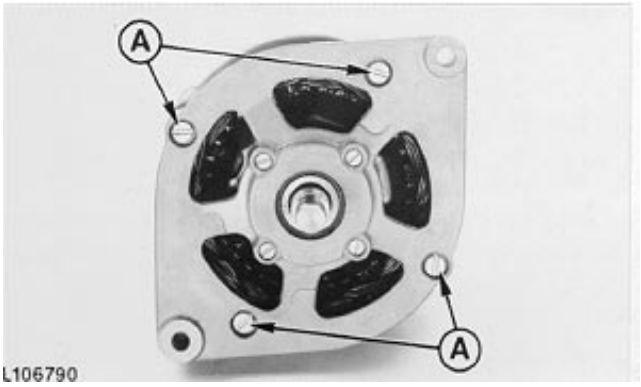
Specification

Alternator Housing Cap Screws—
Torque ..... 4.0—5.5 N•m (33—48 lb-in.)

Check armature end play.

Specification

Armature—End Play..... 0.1—0.3 mm (0.004—0.012 in.)



L106790 –UN–11JUL89

Alternator Assembly

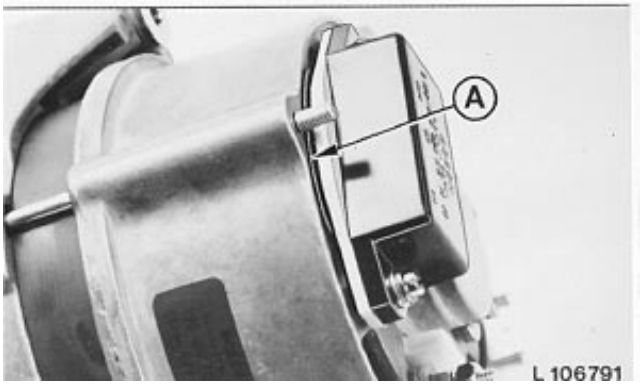
A—Screws (4 Used)

RG,RG34710,2168 –19–21SEP00–1/1

Installing Brush Holder with Regulator

Carefully insert brush holder with regulator. Make sure that gasket (A) fits correctly. Tighten screws securely.

A—Gasket



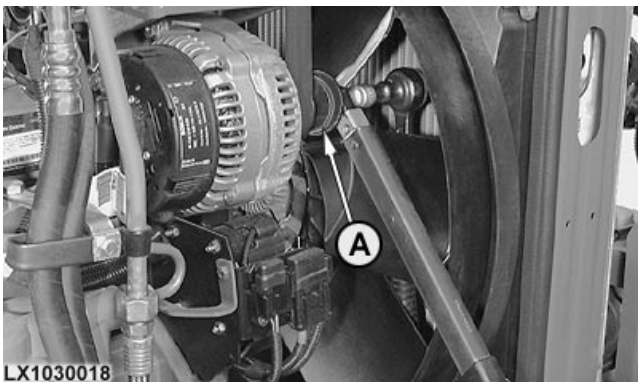
L106791 –UN–11JUL89

Install Brush Holder with Regulator

RG,RG34710,2169 –19–15MAR97–1/1

Fan and Belt Pulley Removal and Installation

A—Pulley



Pulley

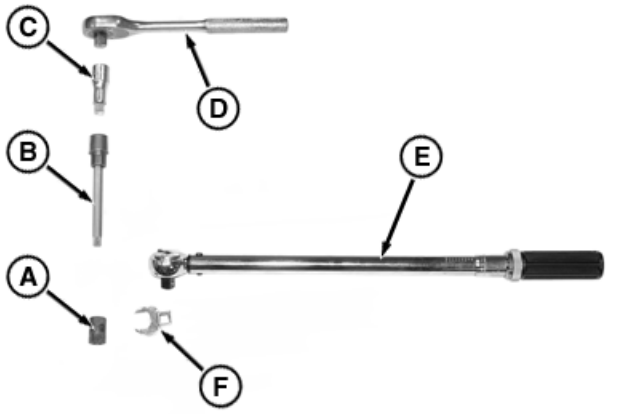
RG,RG34710,2170 –19–07JUL05–1/3

1. Open the hood or panels for access to pulley.

CAUTION: Disconnect negative (-) cable from battery.

IMPORTANT: Always relieve tension on drive belt before removing the pulley.

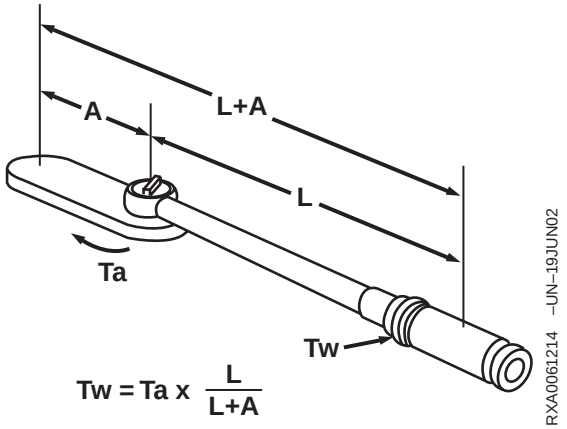
2. Take the drive belt off the pulley.
3. Remove the pulley by installing KJD10227 adapter (A) in alternator pulley.
4. Using extension (C) with ratchet (D) and insert KJD10278 special socket (B) through KJD10227 adapter holding alternator shaft.
5. Use a 17 mm wrench or crows foot (F) with torque wrench (E) to loosen pulley from alternator.



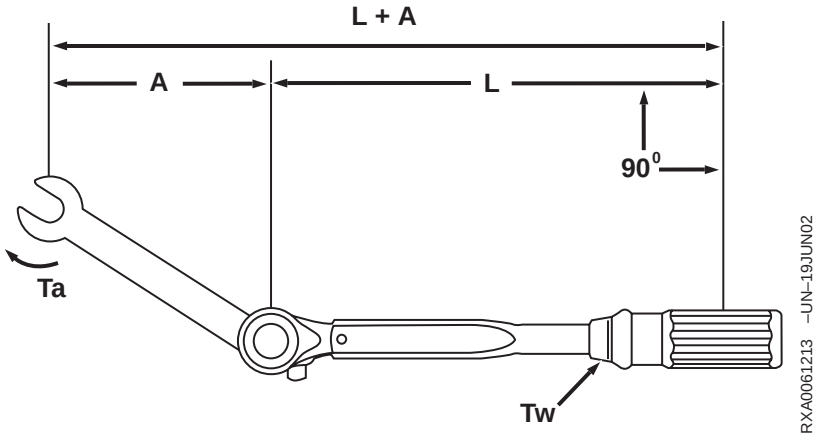
Pulley Tools

Continued on next page

RG,RG34710,2170 –19–07JUL05–2/3



Torque Wrench



Torque Wrench

Tw—Torque setting on wrench **Ta—Torque actually being applied to nut or cap screw** **L—Length from point of force (center of wrench handle) to center of wrench head** **A—Application distance from center of torque wrench head to center of adapter**

6. Using formula with torque wrench tighten alternator pulley to specification.

Item	Measurement	Specification
Alternator Pulley	Torque	80 N•m (60 lb-ft)

NOTE: To install alternator and adjust belt tension, refer to machine technical manual.

RG,RG34710,2170 –19–07JUL05–3/3

Section 35
Valeo Alternators

Contents

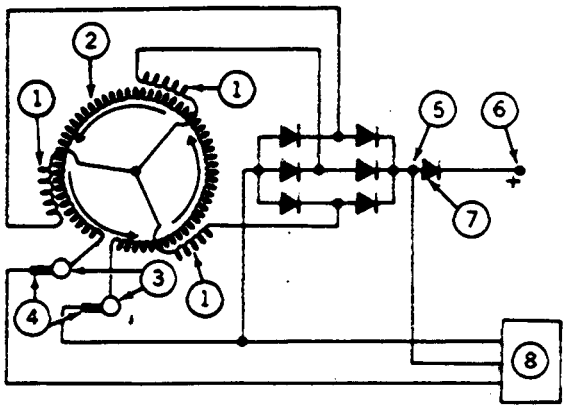
Valeo Alternator Operation

In an alternator, the magnetic field of the rotor is moved across stationary conductors in the stator. This permits a permanent connection between the stator windings and the output terminal. Slip rings are used to transmit the field current to the rotor field winding.

The alternator produces power in the form of a three-phase alternating current and voltage. The alternating current is rectified to direct current by a three-phase full-wave rectifier circuit using six silicon rectifier diodes. Since the diode will pass current in only one direction (from alternator to battery or load), the alternator does not require the use of a cutout relay.

The entire DC output of the system passes through the isolation diode. This provides the system with several distinct advantages. It prevents the battery from discharging through the regulator and alternator field without the use of relays or switches. Electrically, the indicator lamp is connected across the isolation diode. When the system is operating properly, the alternator output voltage is very nearly the same as the battery voltage. This means that the voltage potential across the isolation diode is low and the indicator lamp shows that the alternator is charging.

The alternator output current is controlled by the current flow through the field coil (rotor). The amount of current required is determined and controlled by the regulator. Since there is very little residual magnetism in the alternator, it is necessary to supply a small amount of excitation current to the field (rotor) to start the process of current generation. The excitation resistor supplies this starting current when the key switch is turned on. This resistor is enclosed in the sealed regulator case. Once the alternator is excited, a voltage is developed at the regulator terminal and the voltage regulator takes over control of the system voltage.



T52184 –UN–31MAY89

Valeo Alternator Operation

1—Stator
2—Rotor Winding (Field)
3—Rotor Slip Ring
4—Brushes
5—Regulator Terminal
6—Output Terminal
7—Isolation Diode
8—Regulator

35
05
1

RG,RG34710,2171 –19–15MAR97–1/1

Valeo Regulator Operation

The transistor regulator is an electronic switching device composed principally of transistors, resistor, and diodes to form a completely static unit containing no moving parts.

The transistors are used to switch the alternator field current on and off and are controlled by the resistors and the Zener diode.

A Zener diode is a special diode that will break down and permit a reverse flow of current when the voltage reaches a certain value, without damaging the semiconductor material. This diode is the trigger which senses the maximum desired voltage and turns the transistor on or off to limit charging system voltage.

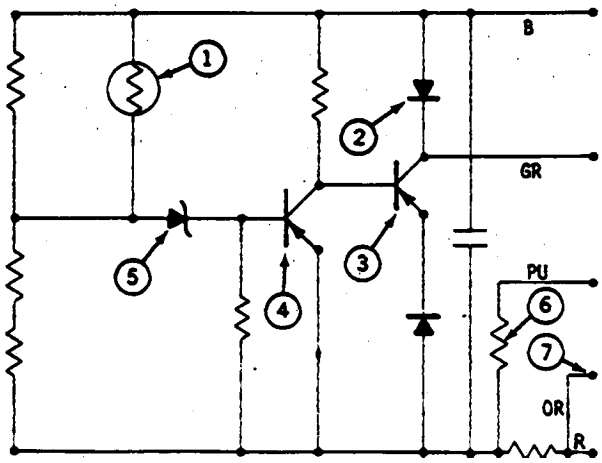
The field discharge diode provides an alternator current path to protect the transistors from induced high voltage from the alternator field windings. The sudden stopping of field current by the transistor and subsequent collapsing of the magnetic field cause an induced voltage in the rotor windings.

The thermistor (RT) is a temperature compensating resistor. Its resistance varies with temperature and controls the operating point of the Zener diode so that a high system voltage is produced in cold weather when needed, and a lower system voltage in warm weather.

When the voltage appearing at the output terminal of the alternator rises to a predetermined value (1.44 volts), the voltage which appears across the Zener diode permits current to flow in the base of transistor T-1. This causes transistor T-1 to turn on and reverse bias transistor T-2, thus turning off the current applied to the alternator field.

When the system voltage drops below the predetermined value, the Zener diode stops conducting, T-1 turns off and T-2 turns on. When transistor T-2 is switched on, field current again is supplied to the alternator.

The operation of transistor T-2 is in effect like a switch, turning the alternator field current on and off as the electrical supply varies due to the varying electrical load. This action occurs many times a second, so fast it cannot be detected in the alternator output.



Valeo Regulator Operation

1—Thermistor (RT)
2—Field Discharge Diode
3—Transistor (T-2)
4—Transistor (T-1)
5—Zener Diode
6—Excitation Resistor
7—To Alternator Indicator Light

35
05
2

Continued on next page

The solid-state regulator is either mounted on rear of alternator or mounted internally. It controls output by controlling current through the field. In operation, the regulator has the following three phases.

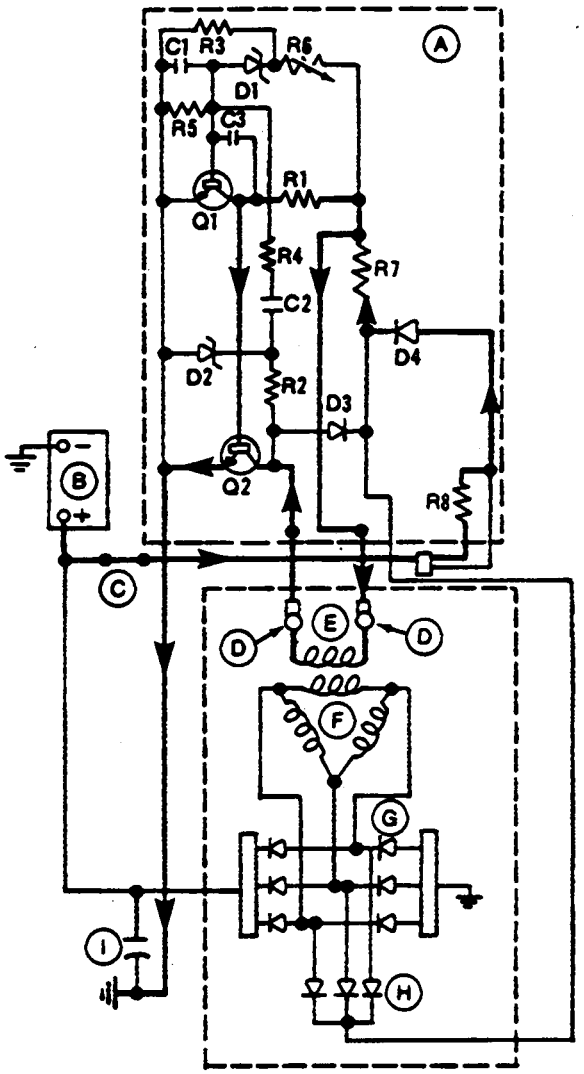
RG,RG34710,2172 –19–06MAY02–2/5

Phase I—Alternator Stopped

(Phase I also applies when alternator is running but only if not running fast enough for output to exceed battery voltage.)

1. Current flows from battery (B) through key switch (C) to regulator (A).
2. From there, current flows through resistors R8, R7, and R1 to transistor Q2, turning it on.
3. Transistor Q2 then provides a path so current can flow through field (E) to ground, enabling alternator to generate electricity.
4. Zener diode D1 prevents flow of current to transistor Q1. A Zener diode is a special type of diode which will not permit current to pass until voltage reaches a certain preset level. If voltage exceeds that level, current can pass through the Zener diode.

A—Regulator
B—Battery
C—Key Switch
D—Rotor
E—Field Windings
F—Delta Stator
G—Rectifier Diodes
H—Diode Trio
I—Suppression Capacitor



N37761 –UN–02MAY89

Phase I—Alternator Stopped

35
05
3

Continued on next page

RG,RG34710,2172 –19–06MAY02–3/5

Phase II—Generating Electricity

1. The key switch (C) and rectifier bridge diodes (G) all have equal voltage. Therefore, no current flows from key switch to regulator.

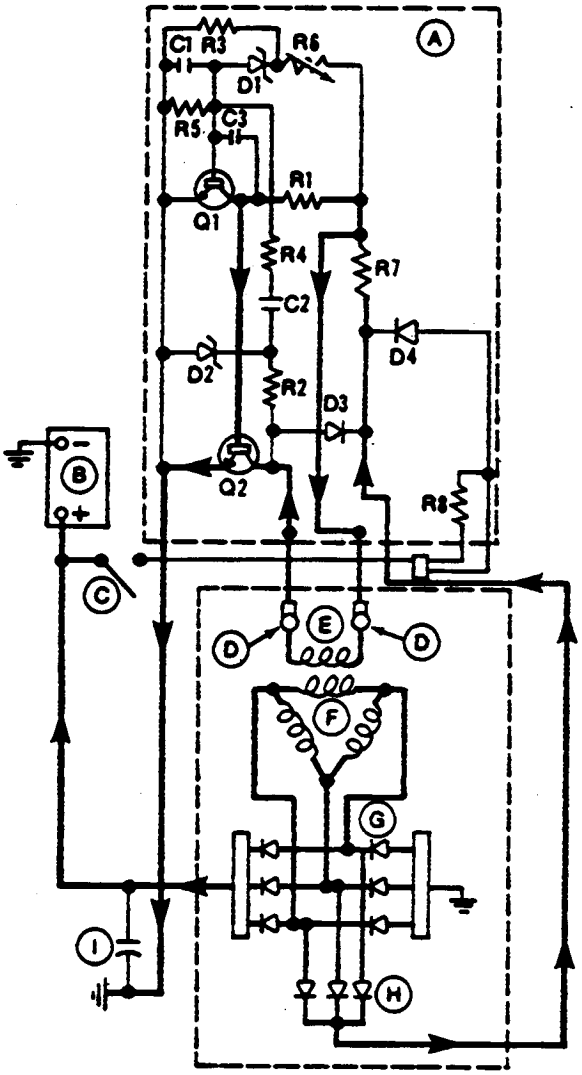
2. Current, now coming from rectifier bridge diodes, flows through resistors R7 and R1 to turn on transistor Q2.

3. Transistor Q2 still provides a path to ground through field (E), enabling alternator to generate electricity.

4. Since the field is rotating, it does generate electricity. Alternating current is induced in the stator windings (F). The rectifier bridge converts it to direct current, providing current to run electrical accessories and charge the battery.

5. Output voltage still has not reached critical voltage of the Zener diode D1.

A—Regulator
B—Battery
C—Key Switch
D—Rotor
E—Field Windings
F—Delta Stator
G—Rectifier Diodes
H—Diode Trio
I—Suppression Capacitor



N37762 –UN–02MAY89

Phase II—Generating Electricity

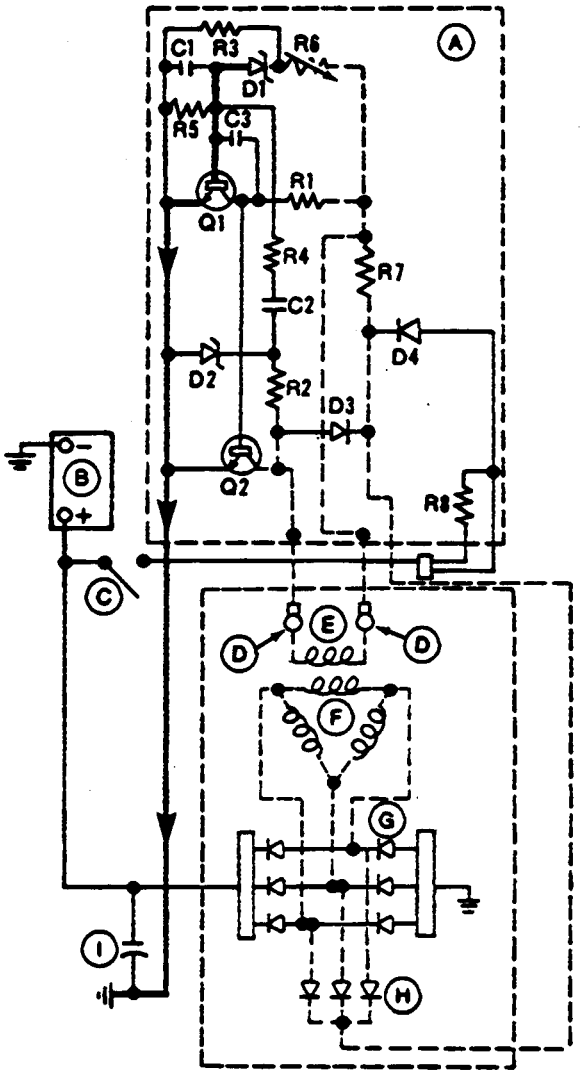
Continued on next page

RG,RG34710,2172 –19–06MAY02–4/5

Phase III—Shut-Off

1. Output voltage reaches critical voltage of Zener diode D1.
2. Current can now pass through Zener diode D1 to turn on control transistor Q1.
3. Current from transistor Q1 cuts off voltage to transistor Q2, turning it off. There is now no path to ground for current through field (E).
4. Current through field is shut off instantly, and alternator stops generating electricity.
5. With transistor Q2 off, system voltage starts to drop in unrestricted fashion until it falls below the Zener diode D1 critical voltage. When this occurs, Zener diode D1 and transistor Q1 switch off and Q2 turns on again.
6. Phases II and III are repeated many times per second to maintain voltage at proper level.

A—Regulator
B—Battery
C—Key Switch
D—Rotor
E—Field Windings
F—Delta Stator
G—Rectifier Diodes
H—Diode Trio
I—Suppression Capacitor



N37763 –UN–02MAY89

Phase III—Shut-Off

35 05 5

RG,RG34710,2172 –19–06MAY02–5/5

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B80 –19–08MAY02–1/3

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUO1004,0000B80 –19–08MAY02–2/3

35
10
1

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000B80 –19–08MAY02–3/3

Other Material

Number	Name	Use
TY16285 (U.S.) CXTY24311 (Canadian) 222 (LOCTITE®)	Thread Lock and Sealer (Low Strength)	Apply to front bearing plate and housing through bolts.

LOCTITE is a registered trademark of Loctite Corp.

OUO1004,0000B82 –19–21SEP00–1/1

Valeo Charging Circuit Repair Specifications

Item	Measurement	Specification
Alternator Housing Through Bolts	Torque	5 N•m (44 lb-in.)
Pulley Nut	Torque	61 N•m (45 lb-ft)
Ground (—) Terminal Nut	Torque	4 N•m (35 lb-in.)
Optional Terminal Nut	Torque	4 N•m (35 lb-in.)
Battery Positive (+) Terminal Nut	Torque	5 N•m (44 lb-in.)

35
10
2

OUO1004,0000B83 –19–21SEP00–1/1

Valeo Charging Circuit Test Specifications

NOTE: Formerly Motorola alternators made in France.

					Min. Output @ 25°C (77°F)	
John Deere Alternator Part No.	**Valeo Alternator Part No.**	**Pulley Grooves**	**Rated Amps**	**Field Current (Volts)**	**Amps**	**RPM**
RE20600	2940090[a]	W/O	35	14	26—30	3000—4000
RE30838	2518033[b]	Dual	35	14	26—30	3000—4000
RE40575	2518032[b]	Single	35	14	26—30	3000—4000
RE40576	2518073[b]	Single	80	14	68—78	3000—4000
[a]With additional resistor.						
[b]With included regulator (Packard connector).						

Item	Specification
Maximum Continuous Speed	12000 rpm
Maximum Intermittent Speed	16000 rpm
Maximum Recommended Working Temperature	80°C (176°F)

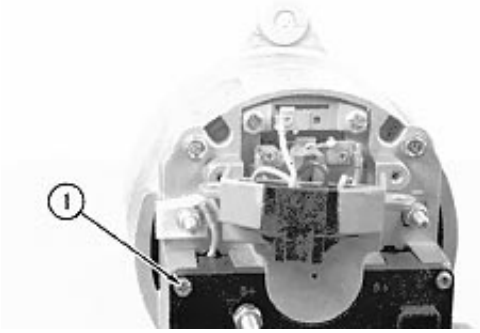
RG,RG34710,2174 –19–07JUL05–1/1

35
10
3

Disassemble Alternator and Test Components

1. Remove regulator after having identified the color coding of the wires.
2. Unscrew the three cover attaching screws (1) and remove cover.

1—Screws (3 Used)



CD5712 –UN–26JUL89

Unscrew Cover Attaching Screws

Continued on next page

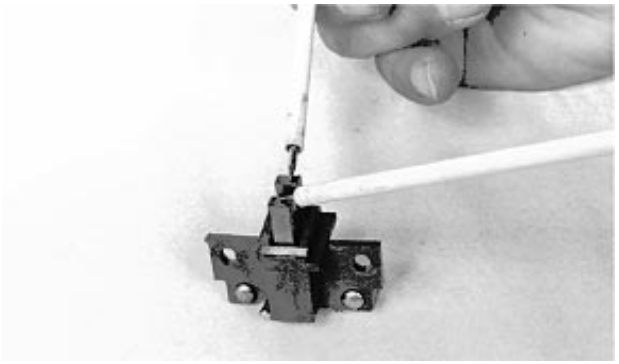
RG,RG34710,2175 –19–15MAR97–1/19

3. Remove the brush assembly with caution and turn it toward the outside in order to protect the brushes.
4. Inspect brushes. If either one is worn, cracked or oil soaked, replace the brush assembly.

Remove Brush Assembly

RG,RG34710,2175 –19–15MAR97–2/19

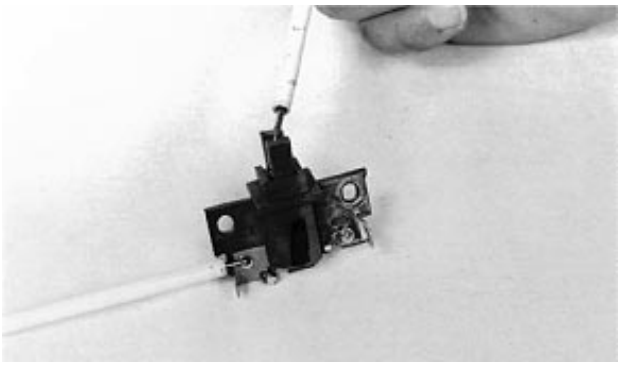
5. Touch each brush with test leads using JT05791 Digital Multimeter. No continuity should be found, even if either brush has slid up or down in its channel. If there is continuity, replace the brush assembly.



JT05791 Digital Multimeter

RG,RG34710,2175 –19–15MAR97–3/19

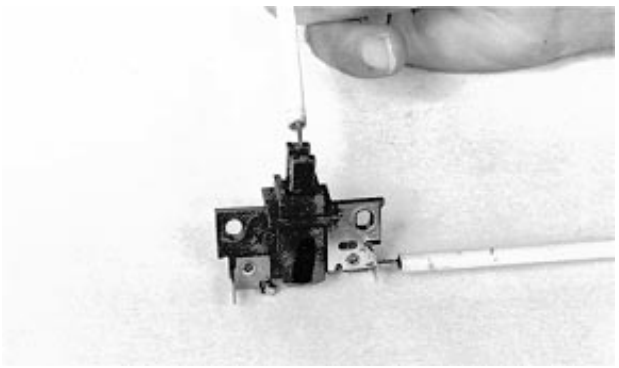
6. Connect the test leads of JT05791 Digital Multimeter on the field terminal and on its corresponding brush. Continuity should be found even when moving brushes. If there is no continuity, replace the brush assembly.



Connect Test Leads

RG,RG34710,2175 –19–15MAR97–4/19

7. Connect the test leads of JT05791 Digital Multimeter on the second terminal and on its corresponding brush. Continuity should be found even when moving brushes. If there is no continuity, replace the brush assembly.



Test for Continuity

Continued on next page

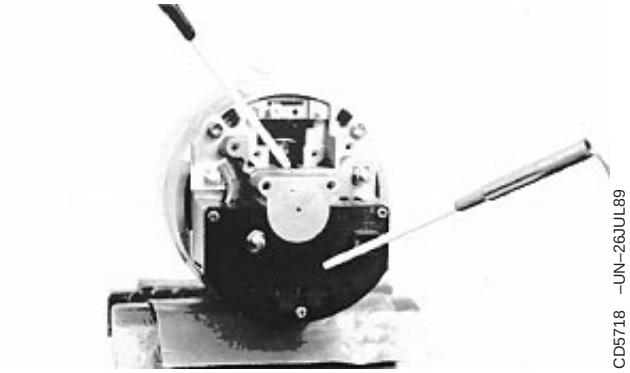
RG,RG34710,2175 –19–15MAR97–5/19

8. Connect the test leads to each slip ring. The resistance must be between 3.8 and 5.2 ohms.
9. Connect an ohmmeter between a slip ring and the alternator housing. The resistance should be infinity.

Test Resistance

RG,RG34710,2175 –19–15MAR97–6/19

10. Check if the winding has been damaged by overheating.
11. Check the stator insulation by connecting an ohmmeter between the alternator housing and in succession with each stator phase winding. The resistance should be infinity.

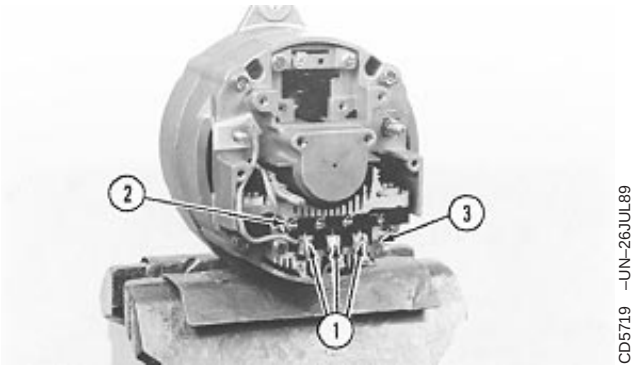


Check the Stator Insulation

RG,RG34710,2175 –19–15MAR97–7/19

12. Unsolder the leads of phase winding (1), and D+ terminal (2).
13. Take out link diode bridge after removing the screws (3).

1—Phase Winding
2—D+ Terminal
3—Screws



Remove Link Diode Bridge

Continued on next page

RG,RG34710,2175 –19–15MAR97–8/19

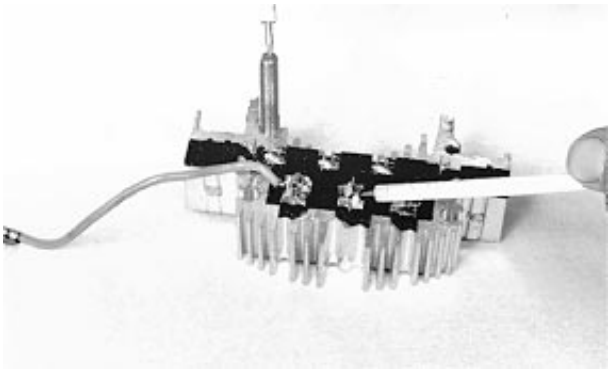
14. Using a power supply not exceeding 12 volts and an indicator lamp in series, check the current flow through each diode.

15. Test positive diodes by connecting the indicator lamp between each phase terminal and the B+ terminal. Just touch the lamp probes briefly.

    If the indicator lamp lights only in one direction, the diode is good. Continue testing diode as outlined in step 16.

    If the indicator lamp lights in both directions, the diode is shorted. Replace diode.

    If the indicator lamp does not light in either direction, the diode circuit is open. Replace diode.



Test Diode

RG,RG34710,2175 –19–15MAR97–9/19

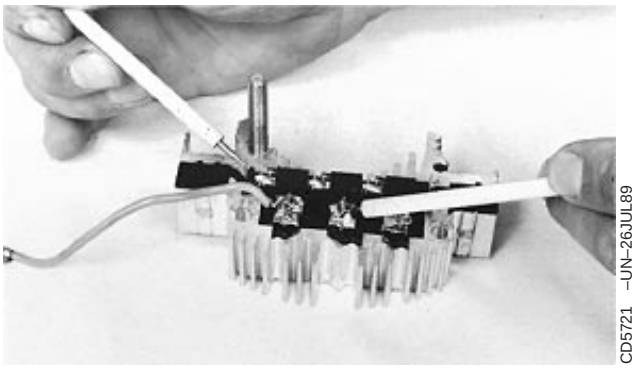
16. Test negative diodes by connecting the lamp between each phase terminal and the heat sink.

    If the indicator lamp lights only in one direction, the diode is good. Continue with step 17.

    If the indicator lamp lights in both directions, the diode is shorted. Replace diode.

    If the indicator lamp does not light in either direction, the diode is open circuit. Replace diode.

17. Test the trio by connecting the test leads on the D+ terminal and on each phase terminal in sequence. Then reverse the polarity.

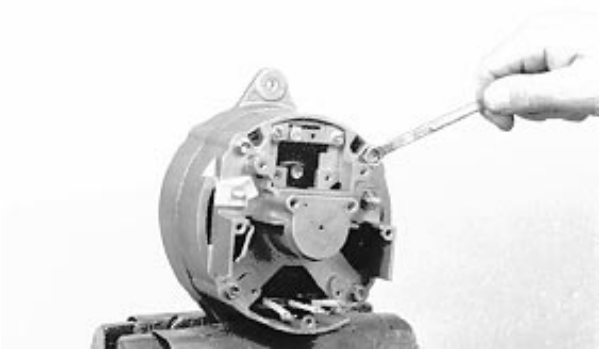


Test Diodes

Continued on next page

RG,RG34710,2175 –19–15MAR97–10/19

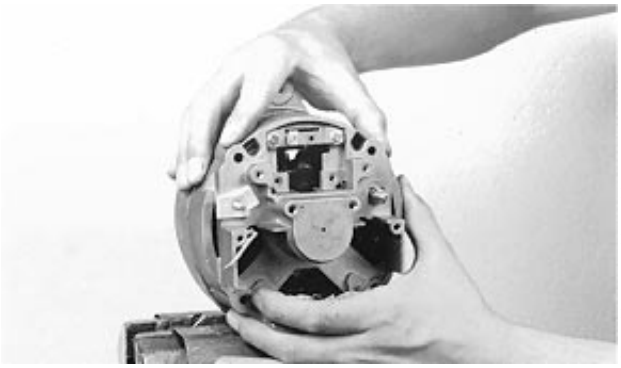
18. Note the orientation of the housing and take out the four through bolts.



Remove Through Bolts

RG,RG34710,2175 –19–15MAR97–11/19

19. Remove the rear housing. If it is glued to the stator, take care not to damage the winding.



Remove Rear Housing

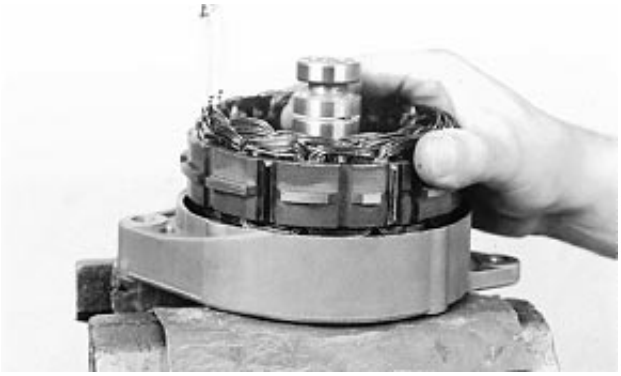
RG,RG34710,2175 –19–15MAR97–12/19

20. Remove O-ring from rear bearing bore.

Remove O-Ring

RG,RG34710,2175 –19–15MAR97–13/19

21. Remove stator from front housing.



Remove Stator

Continued on next page

RG,RG34710,2175 –19–15MAR97–14/19

35
10
7

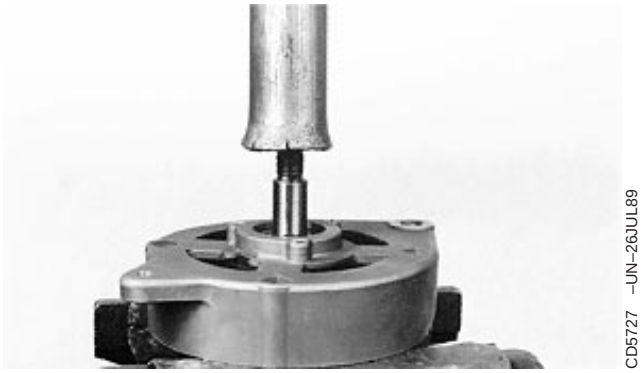
22. Remove pulley nut and lock washer.

23. Pull alternator from pulley. Remove fan.

Remove Pulley Nut and Lock Washer

RG,RG34710,2175 –19–15MAR97–15/19

24. Press rotor out of front housing.



Press Rotor Out

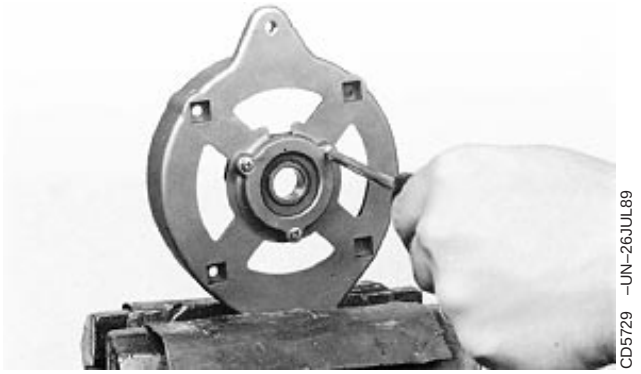
RG,RG34710,2175 –19–15MAR97–16/19

25. Remove rear bearing using a suitable puller.

Remove Rear Bearing

RG,RG34710,2175 –19–15MAR97–17/19

26. Unscrew the three screws securing the bearing plate.



Unscrew Screws

Continued on next page

RG,RG34710,2175 –19–15MAR97–18/19

27. Extract the front bearing.

Extract the Front Bearing

RG,RG34710,2175 –19–15MAR97–19/19

Assemble Alternator

1. Fit the front bearing to its housing by pressing on the outer ring as shown.
2. Install the bearing plate. Apply LOCTITE® 222 Thread Lock and Sealer (low strength) on the threads of the three screws and tighten.

Assemble Alternator

LOCTITE is a registered trademark of Loctite Corp.

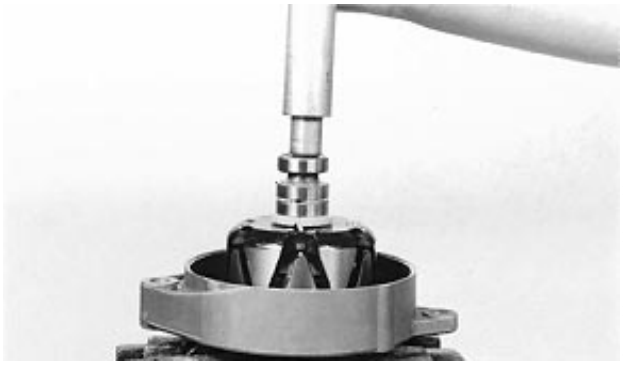
RG,RG34710,2176 –19–15MAR97–1/11

3. Press rear bearing onto rotor using a suitable driver.

Press Rear Bearing onto Rotor

RG,RG34710,2176 –19–15MAR97–2/11

4. Install rotor into front housing.

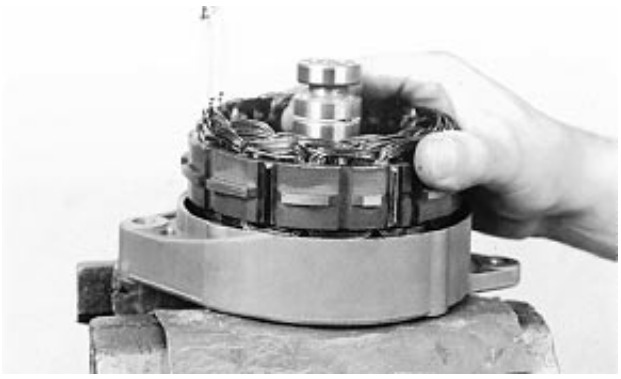


Install Rotor

Continued on next page

RG,RG34710,2176 –19–15MAR97–3/11

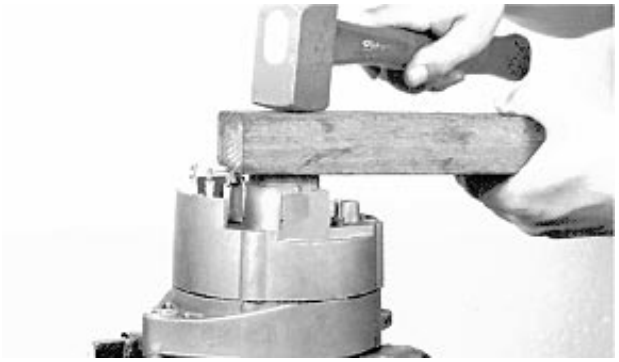
5. Install stator.



Install Stator

RG,RG34710,2176 –19–15MAR97–4/11

6. Install rear housing, taking care that marks made when disassembling are in line. Use a new O-ring in rear bearing bore.



Install Rear Housing

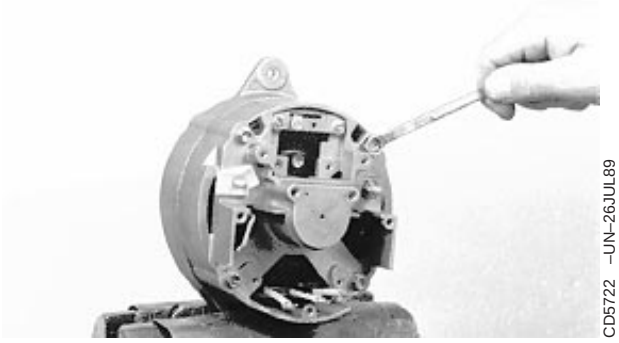
RG,RG34710,2176 –19–15MAR97–5/11

7. Install the four through bolts. Apply LOCTITE® 222 Thread Lock and Sealer (low strength) on the threads of the through bolts and tighten to specifications.

35
10
10

Specification

Alternator Housing Through Bolts—Torque..... 5 N•m (44 lb-in.)



Install Through Bolts

LOCTITE is a registered trademark of Loctite Corp.

RG,RG34710,2176 –19–15MAR97–6/11

8. Install fan.

Install Fan

Continued on next page

RG,RG34710,2176 –19–15MAR97–7/11

9. Install pulley, nut and lock washer. Tighten the pulley nut to specifications.

Specification

Pulley Nut—Torque ..... 61 N•m (45 lb-ft)

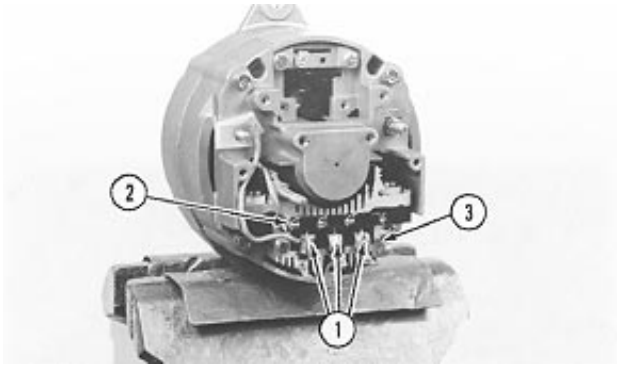
Tighten Pulley Nut

RG,RG34710,2176 –19–15MAR97–8/11

10. Install the diode bridge and tighten screws (3).

11. Solder the leads of phase winding (1) and D+ terminal (2). DO NOT use acid-core solder.

1—Phase Winding
2—D+ Terminal
3—Screws



Install Diode Bridge

RG,RG34710,2176 –19–15MAR97–9/11

12. Install the brush assembly.

Install Brush Assembly

Continued on next page

RG,RG34710,2176 –19–15MAR97–10/11

35
10
11

13. Install the rear cover. Tighten the three screws (1).

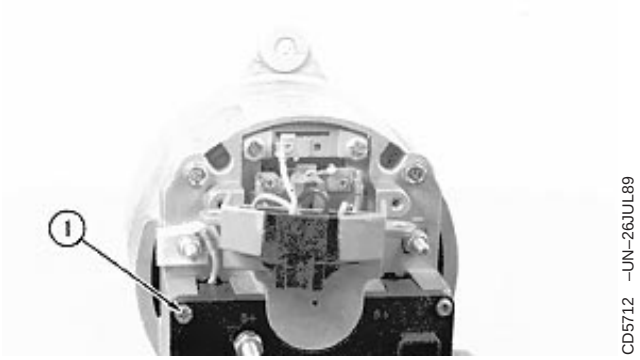
14. Install regulator. It is essential that connections be made correctly; reversals will cause damage.

15. Refer to your machine technical manual for alternator installation and proper V-belt adjustments.

16. Tighten terminal nuts to specifications.

Specification

Ground (—) Terminal Nut—Torque	4 N•m (35 lb-in.)
Optional Terminal Nut—Torque	4 N•m (35 lb-in.)
Battery Positive (+) Terminal Nut—Torque	5 N•m (44 lb-in.)



Installation and Adjustments

1—Screws (3 Used)

RG,RG34710,2176 –19–15MAR97–11/11

35
10
12

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B84 –19–08MAY02–1/3

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUO1004,0000B84 –19–08MAY02–2/3

35
15
1

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000B84 –19–08MAY02–3/3

Valeo A13N-Series Repair Specifications

Item	Measurement	Specification
Ground (B—) Terminal Nut	Torque	4 N•m (35 lb-in.)
Output (B+) Terminal Nut	Torque	5 N•m (44 lb-in.)
Front-to-Rear Housing Through Bolts	Torque	5 N•m (44 lb-in.)
Pulley-to-Shaft Nut	Torque	55 N•m (41 lb-ft)

OUO1004,0000B87 –19–21SEP00–1/1

Valeo A13N-Series Test Specifications

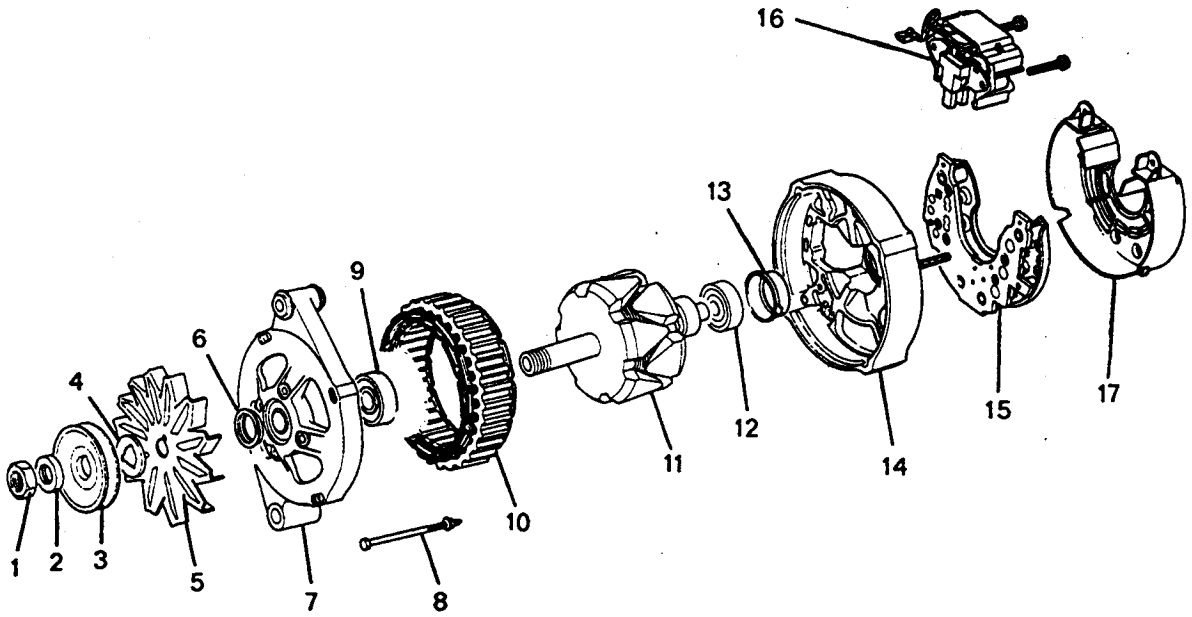
					Min. Output @ 25°C (77°F)	
John Deere Alternator Part No.	**Valeo Alternator Model No.**	**Pulley Grooves**	**Ground**	**Rated (Amps)**	**Amps**	**Alt. RPM**
RE53906	2541673	Single	N	50	39—43	3000—4000

Item	Specification
Rotor winding resistance	3.6 ohms
Stator resistance	0.000 ohms
Alternator output voltage	13.7—14.7 volts
Maximum recommended working temperature	80°C (176°F)
Maximum continuous alternator speed	9000 rpm

35
15
2

RG,RG34710,2177 –19–07JUL05–1/1

Disassemble and Test Valeo A13N-Series Alternator



CD30363 –UN–14APR94

Valeo A13N-Series Alternator

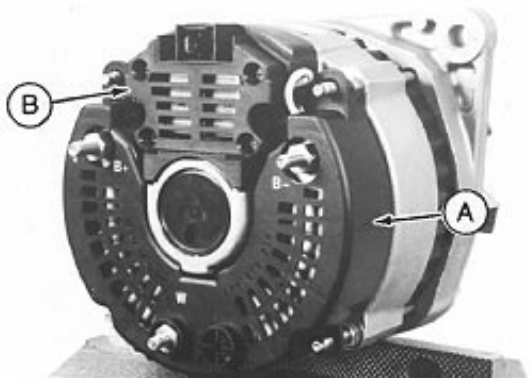
1—Nut
2—Washer
3—Pulley
4—Spacer
5—Fan
6—Fan Spacer
7—Front Housing
8—Through-Bolt (4 Used)
9—Front Ball Bearing
10—Stator
11—Rotor
12—Rear Ball Bearing
13—Plastic Ball Bearing Cage
14—Rear Housing
15—Rectifier Diode Bridge and Diode-Trio Assembly
16—Regulator and Brush Assembly
17—Rear Cover

DPSG,RG34710,102 –19–13SEP99–1/15

35
15
3

1. Pull out the rear cover (A).
2. Remove regulator/brush assembly (B).

A—Rear Cover
B—Regulator/Brush Assembly



CD30364 –UN–14APR94

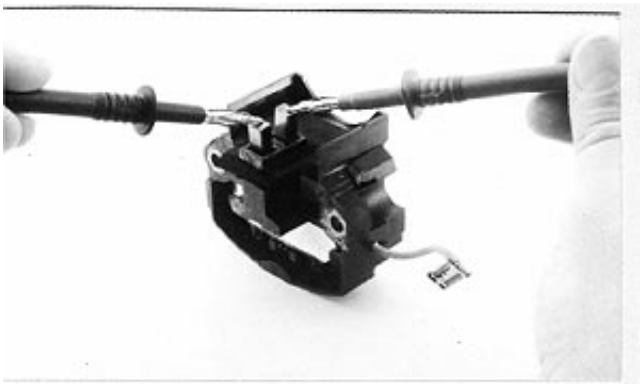
Remove Regulator/Brush Assembly

Continued on next page

DPSG,RG34710,102 –19–13SEP99–2/15

3. Inspect brushes. If either one is worn, cracked or oil soaked, replace the regulator/brushes assembly.

4. Touch each brush with test leads. No continuity should be found even if either brush has slid up or down in its channel. If there is continuity, replace the brush assembly.

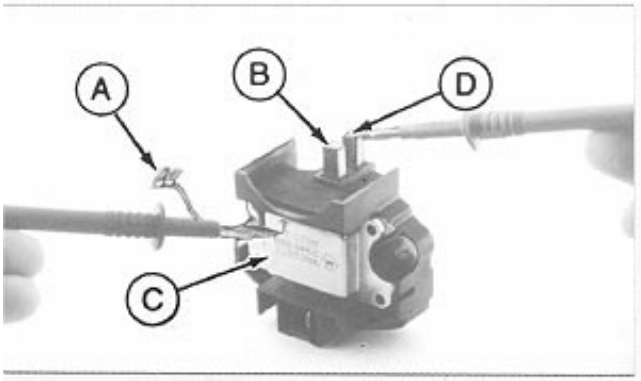


Inspect Brushes

DPSG,RG34710,102 –19–13SEP99–3/15

5. Check for continuity between terminal (A) and brush (B) and between metallic box of regulator (C) and brush (D). If there is no continuity at either brush, replace the brush assembly.

A—Terminal
B—Brush
C—Metallic Regulator Box
D—Brush



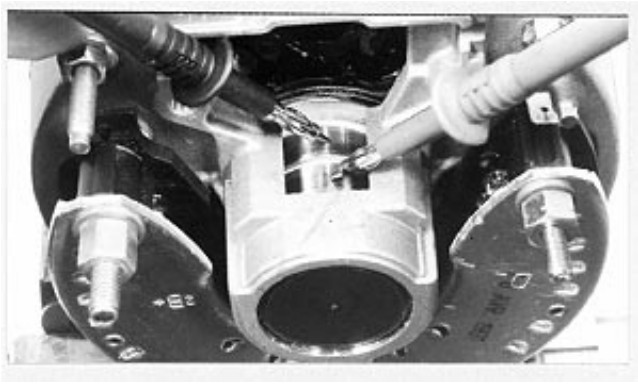
Check for Continuity

Continued on next page

DPSG,RG34710,102 –19–13SEP99–4/15

35
15
4

6. Connect the test leads to each slip ring of the rotor. The ohmmeter should read a resistance of 3.60 ohms.
7. Connect the ohmmeter between a slip ring and the alternator housing. The resistance should be infinity.

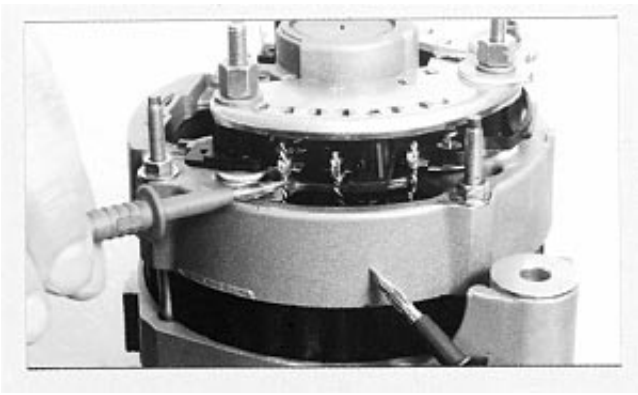


CD30367 –UN–14APR94

Check Resistance

DPSG,RG34710,102 –19–13SEP99–5/15

8. Check if the winding has been damaged by overheating.
9. Check the stator insulation by connecting an ohmmeter between the alternator housing and in succession with each stator phase winding. The resistance should be infinity.



CD30368 –UN–14APR94

Check Winding for Damage

35
15
5

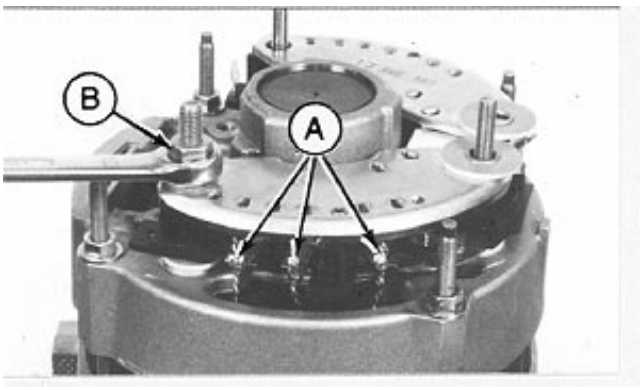
Continued on next page

DPSG,RG34710,102 –19–13SEP99–6/15

10. Unsolder the leads of phase winding (A).

11. Take out the rectifier diode bridge/diode trio assembly after removing the screw and nuts (B).

A—Phase Winding
B—Screw and Nuts



CD30369 –UN–14APR94

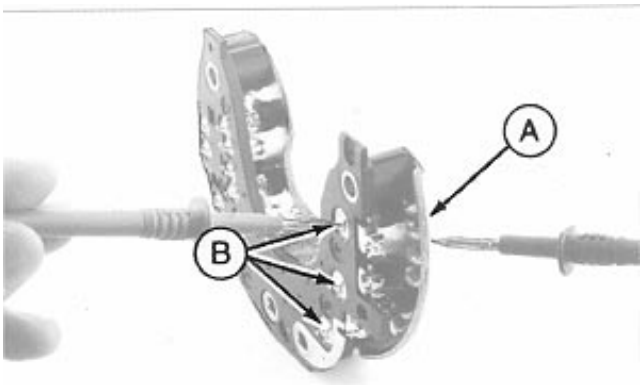
Remove Rectifier Diode Bridge/Diode Trio

DPSG,RG34710,102 –19–13SEP99–7/15

12. Test positive diodes. Test for continuity between the positive plate (A) and each of three terminals (B). Continuity should be observed in one direction only.

    Replace entire rectifier diode bridge if any diode fails test.

A—Positive Plate
B—Three Terminals



CD30370 –UN–14APR94

Test Positive Diodes

Continued on next page

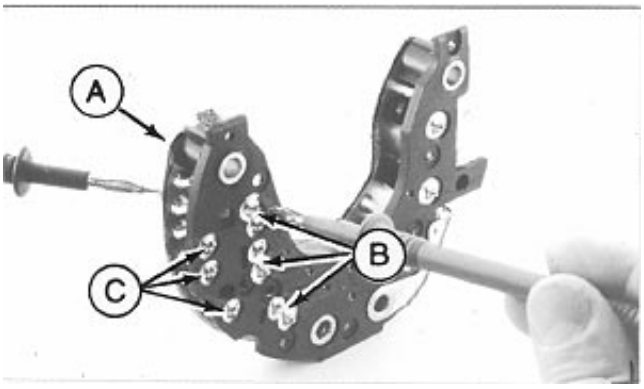
DPSG,RG34710,102 –19–13SEP99–8/15

13. Test negative diodes. Test for continuity between the negative plate (A) and each of three phases (B).

14. Test the diode trio by connecting the test leads on each phase (B) with the corresponding diode trio terminal (C).

    Continuity should be observed in one direction only. Replace entire rectifier diode bridge if any diode fails test.

A—Negative Plate
B—Three Phases
C—Diode Trio Terminal

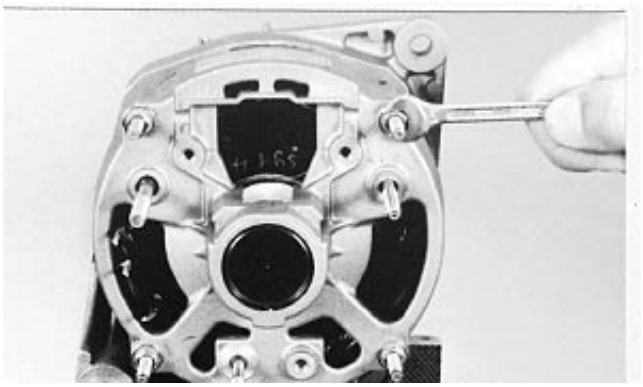


CD30371 –UN–14APR94

Test Negative Diodes

DPSG,RG34710,102 –19–13SEP99–9/15

15. Note the orientation of the housing and take out the four through bolts.

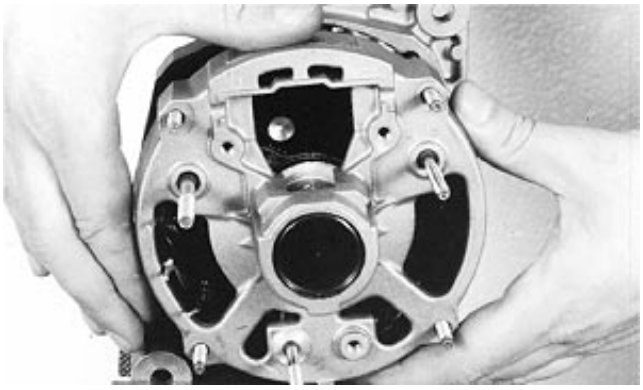

CD30372 –UN–14APR94

Remove Through Bolts

Continued on next page

DPSG,RG34710,102 –19–13SEP99–10/15

16. Remove the rear housing. If it is glued to the stator, take care not to damage the winding.



Remove Rear Housing

DPSG,RG34710,102 –19–13SEP99–11/15

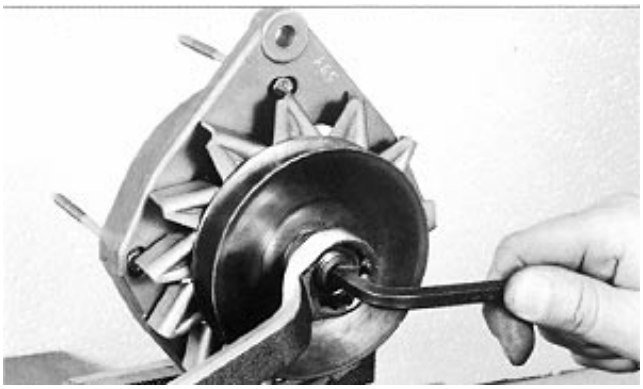
17. Remove stator from housing.

Remove Stator

DPSG,RG34710,102 –19–13SEP99–12/15

35
15
8

18. Remove pulley and fan. Note the order of washers and spacers to ensure a proper reinstallation.

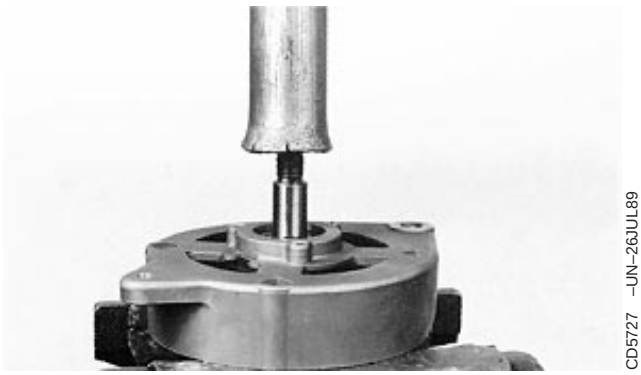


Remove Pulley and Fan

Continued on next page

DPSG,RG34710,102 –19–13SEP99–13/15

19. Press rotor out of front housing.



Press Rotor Out of Front Housing

DPSG,RG34710,102 –19–13SEP99–14/15

20. Remove rear ball bearing using a suitable puller.

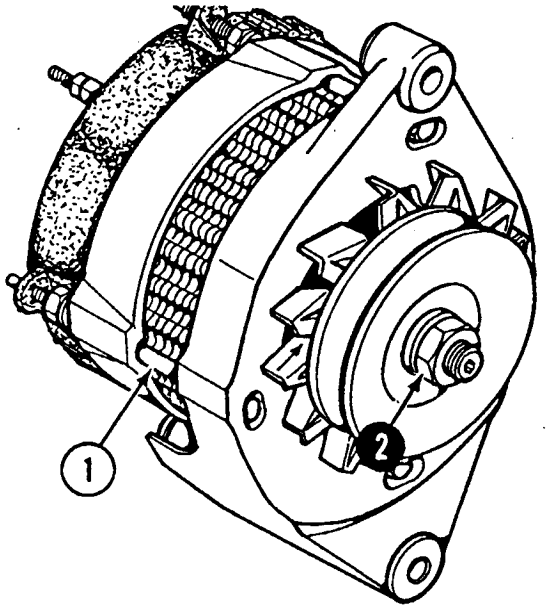
NOTE: Since the front ball bearing is set in front housing, it cannot be removed. If required, replace the front housing/ball bearing assembly.

Remove Rear Ball Bearing

DPSG,RG34710,102 –19–13SEP99–15/15

35
15
9

Assemble Valeo A13N-Series Alternator



Valeo A13N-Series Alternator

1—Through Bolt (4 Used) **2—Pulley Nut**

Assemble alternator in the reverse sequence of disassembly procedure using the following torque specifications.

Item	Measurement	Specification
Ground (B—) Terminal Nut	Torque	4 N•m (35 lb-in.)
Output (B+) Terminal Nut	Torque	5 N•m (44 lb-in.)
Front-to-Rear Housing Through Bolts	Torque	5 N•m (44 lb-in.)
Pulley-to-Shaft Nut	Torque	55 N•m (41 lb-ft)

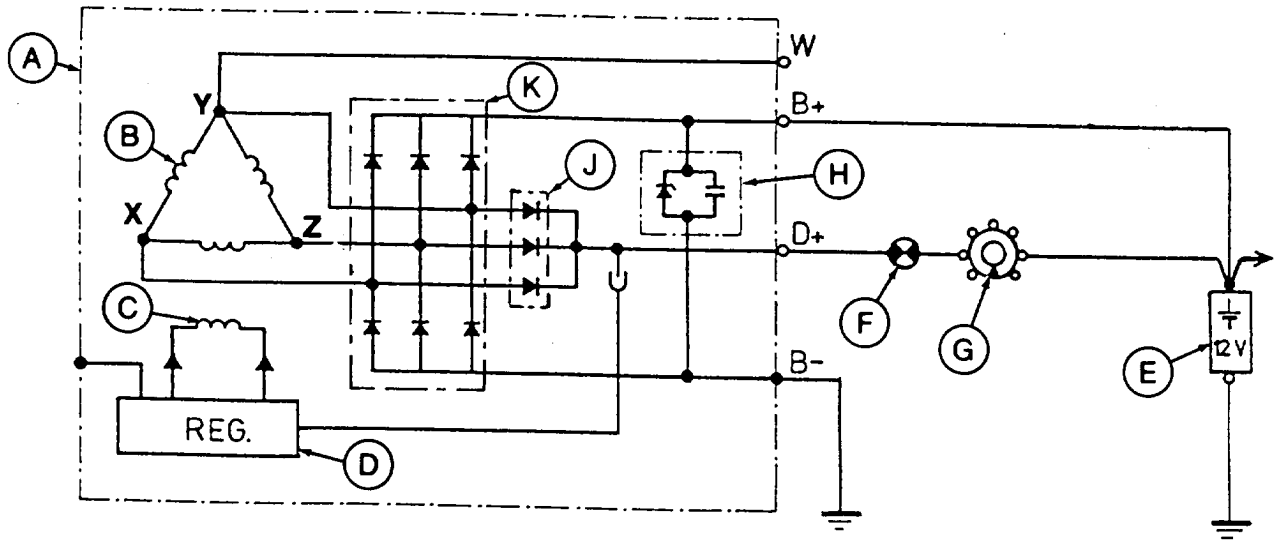
RG,RG34710,2178 –19–15MAR97–1/1

35
15
10

Section 40
Magneton Alternators

Contents

Operation of Alternator



CD30489 –UN–07JAN97

Magneton Alternator

A—Alternator
B—Current Coil (Stator)
C—Exciting Coil (Rotor)
D—Regulator
E—Battery
F—Indicator Light
G—Ignition
H—Protection Device
J—Diode Trio
K—Rectifier Diode Bridge

The Magneton alternator is a synchronous three-phase generator. The current coil is located in the stator, and the exciting current is supplied by the diode trio (J) through the regulator (D+ circuit), two carbon brushes and slip rings to the exciting coil in the rotor.

The alternator is normally driven by the fan belt from the engine crankshaft. The rotor is supported by two permanently lubricated bearings.

The alternator generates alternating current which is then transformed into direct current by the rectifier diode bridge (K).

The alternating windings are delta-connected. The coil ends X, Y, and Z are connected to the rectifier diode as shown. Alternating current is generated in each stator coil (B) of the alternator. During one revolution of the rotor (C), the voltage in the stator coil rises from 0 to the positive maximum, drops to 0, rises to the negative maximum and again drops to 0. The current then flows through the diode and terminal B+ directly to the positive pole of the battery.

A sealed electronic regulator is used to regulate alternator voltage. This regulator, which cannot be adjusted, limits the alternator voltage to approximately 14 volts.

A protection device (H), including a Zener diode and a capacitor, protects diode from voltage surges and suppresses radio interference.

40
05
1

RG,RG34710,2179 –19–06MAY02–1/1

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B88 –19–08MAY02–1/3

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUO1004,0000B88 –19–08MAY02–2/3

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000B88 –19–08MAY02–3/3

Magneton Charging Circuit Repair Specifications

Item	Measurement	Specification
Brush	Minimum Exposed Length	7 mm (0.27 in.)
Rectifier Bridge-to-Rear Housing Nuts	Torque	3 N•m (27 lb-in.)
Capacitor Mounting Nut	Torque	3 N•m (27 lb-in.)
B+ Terminal Nut	Torque	4 N•m (35 lb-in.)
“W” Terminal Nut	Torque	3 N•m (27 lb-in.)
Front-to-Rear Housing Bolts	Torque	3 N•m (27 lb-in.)
Alternator Pulley Nut	Torque	40 N•m (29 lb-ft)

OUO1004,0000B8B –19–21SEP00–1/1

Magneton Charging Circuit Test Specifications

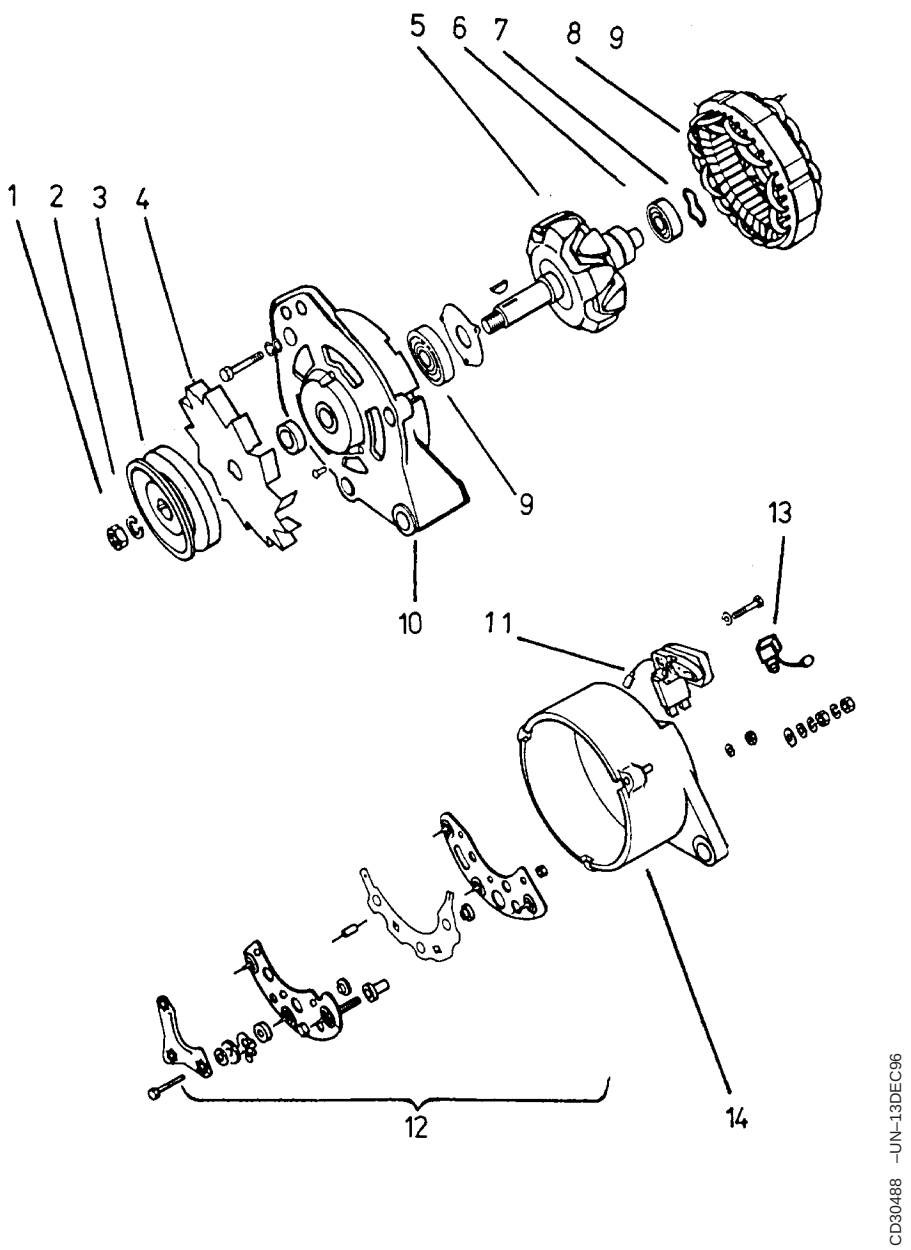
John Deere Alternator Part No.	Magneton Alternator Model No.[a]	Rated Amps	Nominal Voltage	Nominal Alternator rpm	Pulley Grooves
RE500502	9516-763	55	14	6000	Single
RE501634	443 113 516 241	55	12	6000	Poly-Vee
RE503543	443 113 516 971	40	24	6000	Poly-Vee
RE506196	9515-241	55	14	6000	Poly-Vee
RE506197	9515-765	55	12	6000	Single
RE57960	443 113 516 765	55	14	6000	Single
RE57961[b]	443 113 516 762	55	14	6000	Dual
RE70779	443 113 516 875	40	24	6000	Single
RE70780	443 113 516 872	40	24	6000	Dual
[a]Magneton Alternators are now manufactured by Pal-Mag Company (since 1988).					
[b]Not a service part. Order RE57960.					

Item	Specification
Rotor winding resistance	2.95 ohms
Stator resistance	0.00 ohms
Alternator output voltage	13.5—14.2 volts
Working temperature range	-40°C—+90°C
Maximum D+ terminal current load	0.5 amp
Maximum continuous alternator speed	13000 rpm

40
10
3

RG,RG34710,2181 –19–07JUL05–1/1

Exploded View of Alternator



Alternator—Exploded View

1—Pulley Nut, M14 x 1.5
2—Lock Washer
3—Pulley[1]
4—Fan
5—Rotor
6—Rear Bearing
7—Spring Collar
8—Stator
9—Front Bearing
10—Front Housing
11—Regulator and Brush Assembly[1]
12—Rectifier Bridge Assembly[1]
13—Capacitor[1]
14—Rear Housing

[1] Available as service parts.

RG,RG34710,2182 –19–15MAR97–1/1

Identification

The information for parts identification is stamped on the body of the alternator.

CD30470 –UN–13DEC96

Parts Identification

RG,RG34710,2183 –19–15MAR97–1/1

40
10
5

Troubleshooting

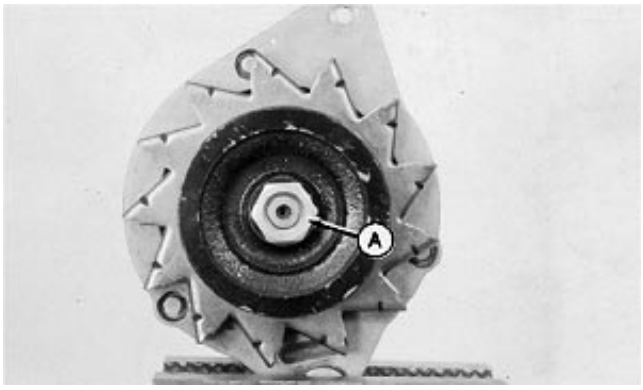
Symptom	Problem	Solution
Alternator indicator light stays off with ignition on and engine not running.	Loose connection	Check
	Regulator failure	Replace brush/regulator assembly
	Stator failure (short-circuit)	Replace complete alternator.
Alternator indicator light stays on with engine running (alternator is not charging) at any speed.	Drive belt loose or broken	Adjust tension or replace
	Loose connection	Check
	Brush/regulator or capacitor failure	Replace
	Diode failure	Replace complete rectifier bridge
	Stator failure	Replace complete alternator
	Rotor failure	Replace complete alternator
Alternator indicator light stays on with engine running (alternator is not charging) at low speed.	Alternator speed too low	Use smaller alternator pulley
Battery overcharging.	Low electrical consumption	Use regulator with narrower regulation range (RE69380)
	Regulator failure	Replace

RG,RG34710,2184 –19–19OCT00–1/1

Disassembly of Alternator

1. Remove pulley nut (A), lock washer, pulley and fan from shaft.

A—Pulley Nut

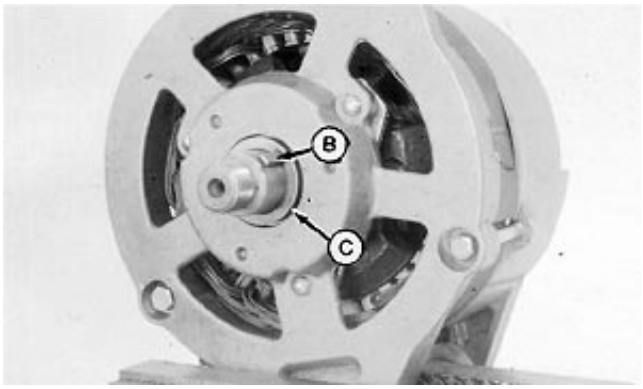


Remove Pulley Nut

RG,RG34710,2185 –19–12SEP02–1/7

2. Remove shaft key (B) and spacer (C) from shaft.

B—Shaft Key
C—Spacer



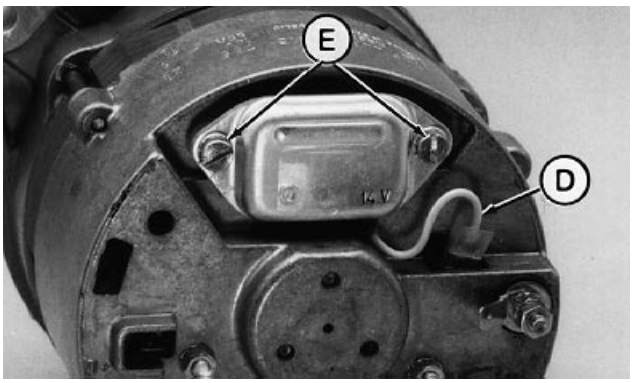
Remove Shaft Key and Spacer

Continued on next page

RG,RG34710,2185 –19–12SEP02–2/7

3. Disconnect wire (D) from terminal. Remove screws and washers (E). Remove brush/regulator assembly by tilting top of regulator up and away from alternator.

D—Wire
E—Screws and Washers



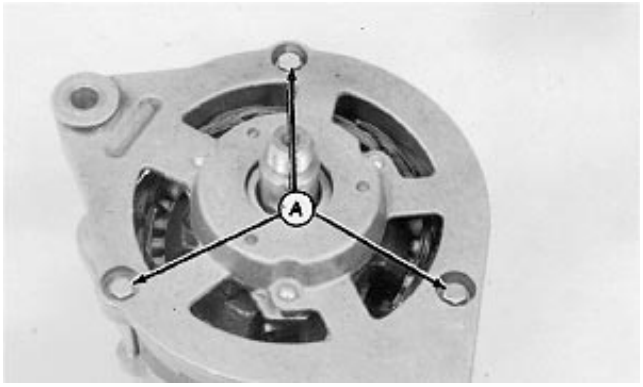
CD30471 –UN–13DEC96

Remove Brush/Regulator Assembly

RG,RG34710,2185 –19–12SEP02–3/7

4. Remove the three bolts (A) from front housing side.

A—Bolts (3 Used)



ZT0616 –UN–01FEB94

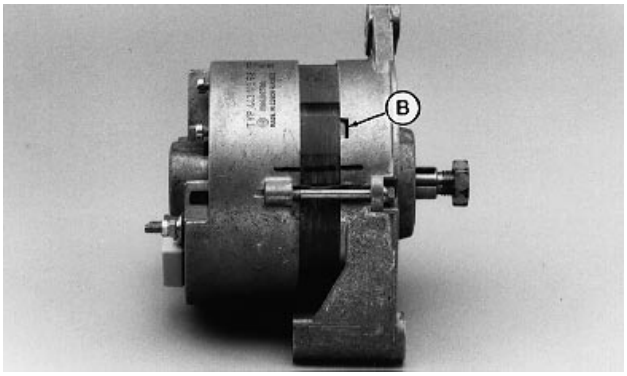
Remove Bolts

40
10
8

RG,RG34710,2185 –19–12SEP02–4/7

5. Place alignment marks along the alternator to note the orientation of housings. Split alternator by carefully prying at slot (B) using a screwdriver against housing.

B—Slot



CD30472 –UN–13DEC96

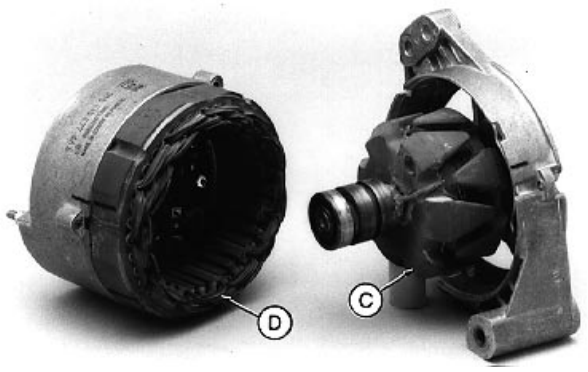
Split Alternator

Continued on next page

RG,RG34710,2185 –19–12SEP02–5/7

6. Remove rotor/front housing assembly (C) from stator/rear housing assembly (D).

C—Rotor/Front Housing Assembly
D—Stator/Rear Housing Assembly

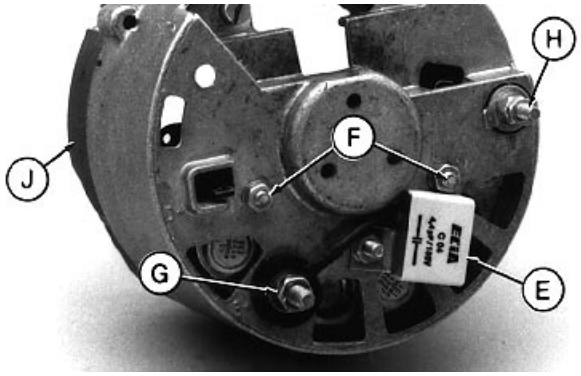


Housing Assemblies

RG,RG34710,2185 –19–12SEP02–6/7

7. Remove capacitor (E). Remove nuts and washers (F) from rear housing. Remove "B+" terminal nut and washers (G). Remove "W" terminal nut and washers (H). Remove stator/rectifier bridge assembly (J) from rear housing.

E—Capacitor
F—Nuts and Washers (2 Used)
G—"B+" Terminal Nut and Washers
H—"W" Terminal Nut and Washers
J—Stator/Rectifer Bridge Assembly



Remove Capacitor

RG,RG34710,2185 –19–12SEP02–7/7

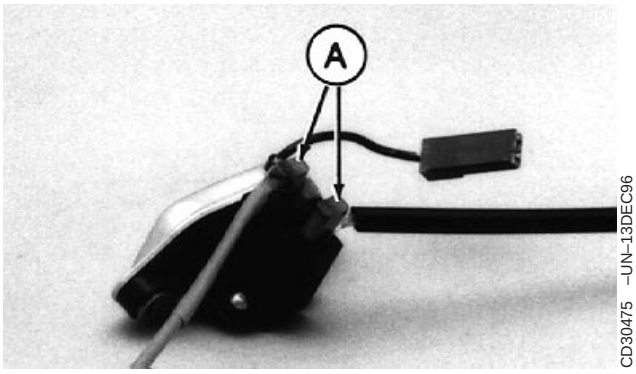
Testing Brush/Regulator Assembly

1. Check brushes (A) for free movement against spring tension. If either brush is worn beyond specification, replace the brush/regulator assembly. Also replace if the brushes are cracked or oil-soaked.

Specification

Brush—Minimum Exposed Length..... 7 mm (0.27 in.)

2. Touch each brush with meter test leads. No continuity should be found, even if either brush can slip up or down in its channel. If there is continuity, replace the brush/regulator assembly.



Check Brushes

A—Brushes

40
10
9

Continued on next page

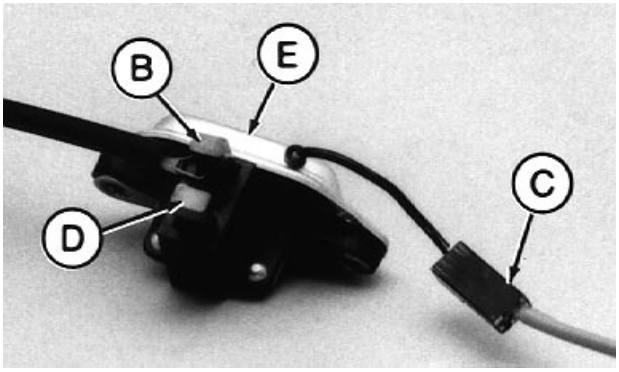
RG,RG34710,2186 –19–15MAR97–1/2

3. Check for continuity between brush (B) and wire (C).

4. Connect regulator to an electrical source corresponding to the nominal voltage, the "+" at the wire (C) and the "—" (ground) on the body (E). Continuity between brush (D) and body should be observed in one direction only.

   If defective, replace the brush/regulator assembly.

B—Brush
C—Wire
D—Brush
E—"—" Body Ground



CD30476 –UN–13DEC96

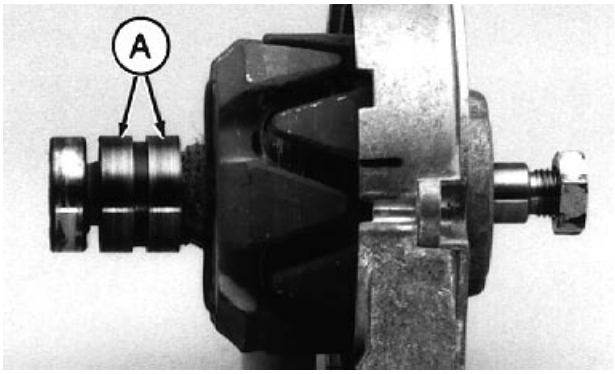
Check for Continuity

RG,RG34710,2186 –19–15MAR97–2/2

Testing Rotor

1. Inspect slip rings (A) of rotor for scoring or rough surface. Polish slip rings sparingly with No. 00 sandpaper.

A—Slip Rings



CD30477 –UN–13DEC96

Inspect Slip Rings

RG,RG34710,2187 –19–15MAR97–1/2

2. Connect ohmmeter between both slip rings of the rotor. Resistance should be 2.95 ohms.

3. Check the rotor for insulation by connecting an ohmmeter between each slip ring and shaft (B). Resistance should be infinity.

   If insulation, resistance or slip ring are defective, replace complete alternator.

B—Shaft

CD30478 –UN–13DEC96

Slip Ring and Shaft

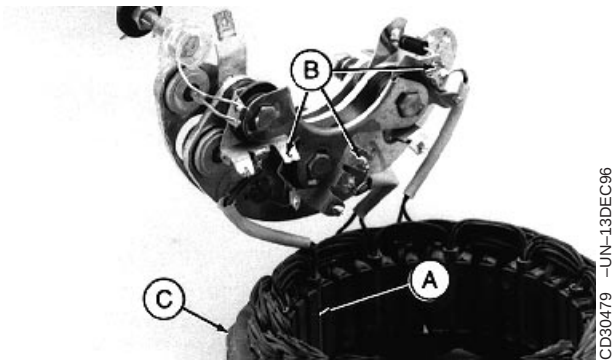
RG,RG34710,2187 –19–15MAR97–2/2

Testing Stator/Rectifier Bridge Assembly

1. Inspect stator winding (A) for discoloration or a burned odor indicating a short circuit.
2. Check stator for grounds by connecting an ohmmeter between each stator lead (B) and stator frame (C). Resistance should be infinity.

   Replace complete alternator if any defect is noted.

A—Stator Winding
B—Stator Lead
C—Stator Frame

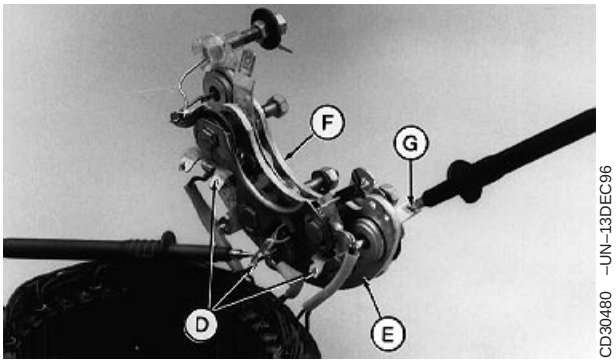


Test Stator/Rectifier Bridge Assembly

RG,RG34710,2188 –19–15MAR97–1/2

3. Check positive diodes by connecting an ohmmeter between each phase terminal (D) and the “B+” plate (E), then reverse the polarity.
4. Check negative diodes by connecting an ohmmeter between each phase terminal (D) and the “B—” plate (F) or ground, then reverse the polarity.
5. Check the diode trio by connecting an ohmmeter between each phase terminal (D) and the “D+” terminal (G), then reverse the polarity.

   A diode with a high reading in one direction and a low reading in the other direction is good. A diode with the same reading in both directions is bad. If any diode fails the test, replace the entire rectifier bridge.



Check Positive Diodes

D—Phase Terminal
E—“B+” Plate
F—“B—” Plate
G—“D+” Terminal

40
10
11

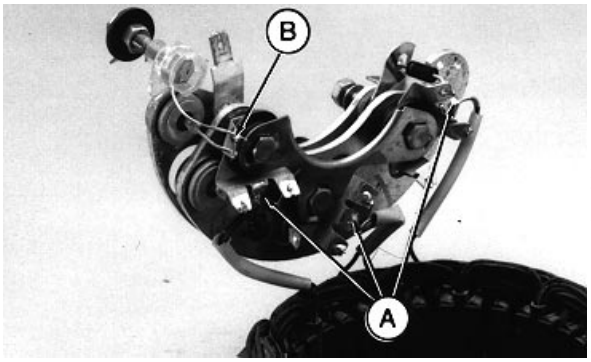
RG,RG34710,2188 –19–15MAR97–2/2

Rectifier Bridge Replacement

1. To replace the rectifier bridge, unsolder the leads of phase winding (A) and “W” terminal (B) using a soldering iron.

2. Position the replacement rectifier bridge and solder phase winding leads. Solder “W” terminal at the proper location.

A—Phase Winding
B—“W” Terminal



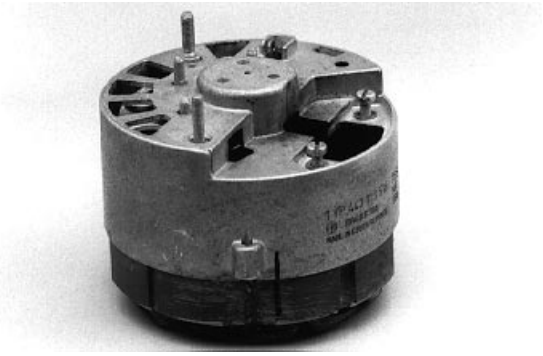
Rectifier Bridge Replacement

RG,RG34710,2189 –19–15MAR97–1/1

Reassembly of Alternator

NOTE: Refer to exploded view earlier in this group.

1. Install stator and rectifier bridge into rear housing using alignment mark.



Reassembly of Alternator

Continued on next page

RG,RG34710,2190 –19–15MAR97–1/6

40
10
12

2. Secure rectifier bridge to rear housing by the two nuts and washers (A). Install capacitor (B) with nut and washer (C). Tighten nuts (A) and (C) to specifications.

Specification

Rectifier Bridge-to-Rear Housing
Nuts—Torque ..... 3 N•m (27 lb-in.)
Capacitor Mounting Nut—Torque ..... 3 N•m (27 lb-in.)

3. Install insulated washer, flat washer, capacitor wire, lock washer and nut on “B+” terminal (D). Tighten to specification.

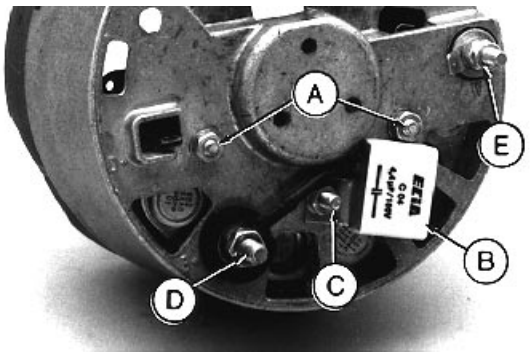
Specification

B+ Terminal Nut—Torque ..... 4 N•m (35 lb-in.)

4. Install insulated washer, flat washer, spade terminal, lock washer and nut on “W” terminal (E). Tighten to specifications.

Specification

“W” Terminal Nut—Torque ..... 3 N•m (27 lb-in.)



CD30483 –UN–13DEC96

Install Parts

A—Nuts and Washers (2 Used)
B—Capacitor
C—Nut and Washer
D—“B+” Terminal
E—“W” Terminal

RG,RG34710,2190 –19–15MAR97–2/6

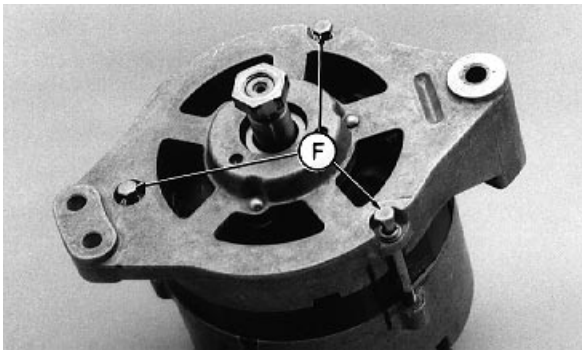
5. Place rotor/front housing assembly into rear housing using alignment marks. Press by hand for final installation.

6. Install the three mounting bolts (F) with washers. Tighten to specifications.

Specification

Front-to-Rear Housing Bolts—
Torque ..... 3 N•m (27 lb-in.)

F—Mounting Bolts (3 Used)



CD30484 –UN–13DEC96

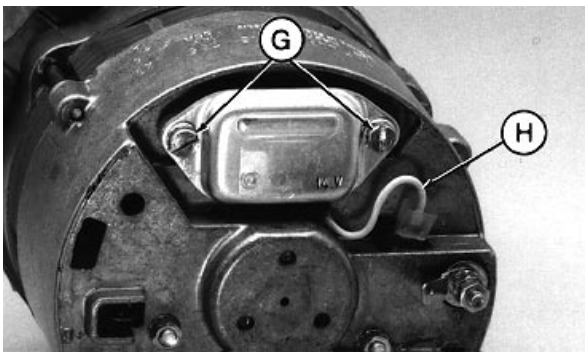
Install Mounting Bolts

Continued on next page

RG,RG34710,2190 –19–15MAR97–3/6

7. Install brush/regulator assembly with caution. Tilt it so that the brushes contact the rotor slip rings. Secure brush/regulator with the two screws and washers (G). Attach wire to terminal (H).

G—Screws and Washers (2 Used)
H—Terminal



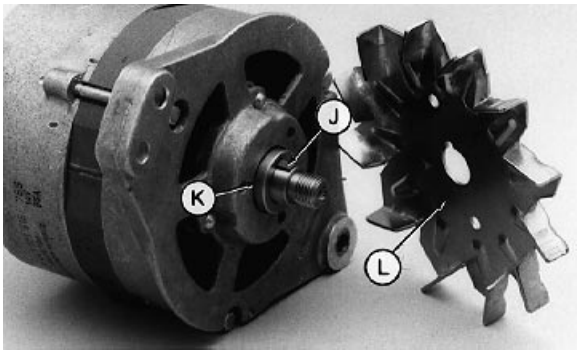
CD30485 –UN–13DEC96

Install Brush/Regulator Assembly

RG,RG34710,2190 –19–15MAR97–4/6

8. Install shaft key (J), spacer (K) and fan (L).

J—Shaft Key
K—Spacer
L—Fan



CD30486 –UN–13DEC96

Install Shaft Key, Spacer, and Fan

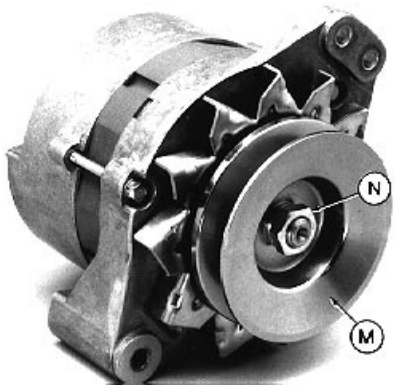
RG,RG34710,2190 –19–15MAR97–5/6

9. Install pulley (M) with lock washer and nut (N). Tighten to specifications.

Specification

Alternator Pulley Nut—Torque ..... 40 N•m (29 lb-ft)

M—Pulley
N—Lock Washer and Nut



CD30487 –UN–16DEC96

Install Pulley

RG,RG34710,2190 –19–15MAR97–6/6

Installation of Alternator

Refer to machine technical manual to install alternator and to adjust belt tension.

RG,RG34710,2191 –19–15MAR97–1/1

Section 45
Leece-Neville Alternators

Contents

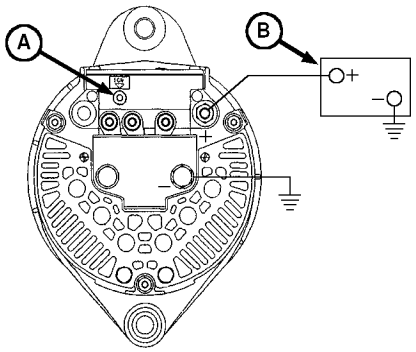
Alternator Operation

Vehicle battery power is applied to the ignition terminal (A), to supply excitation to the field coil (rotor coil) through the regulator and brushes. This creates a magnetic field around the rotor and through the stator.

When the rotor is set in motion, the moving magnetic field induces an alternating current (AC) in the stator windings. This output current increases with the speed of the rotor.

The AC produced in the stator is converted to direct current (DC) by the positive and negative rectifier assemblies. The rectifier assemblies are connected to the alternator output terminals to provide DC output for charging the batteries and to satisfy the vehicle electrical loads.

The adjustable regulator monitors the output voltage through sensing leads which are connected to the positive and negative rectifier assemblies. When the output voltage deviates from the set voltage, the regulator takes corrective action to maintain the output voltage at the proper level.



RG11155 –UN–12SEP00

Alternator Operation

A—Ignition Terminal
B—Battery

OUO1004,0000B34 –19–11SEP00–1/1

45
05
1

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B8C –19–08MAY02–1/3

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

OUO1004,0000B8C –19–08MAY02–2/3

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000B8C –19–08MAY02–3/3

Leece-Neville Repair Specifications

Item	Measurement	Specification
Alternator Pulley Nut	Torque	95—108 N•m (70—80 lb-ft)

OUO1004,0000B3B –19–13SEP00–1/1

45
10
1

Leece-Neville Charging Circuit Test Specifications

John Deere Alternator Part No.	Leece-Neville Alternator Part No.	Volts	Rated Amps
RE500920	A0014860JB	12	200
RE522329	A0014730LC	24 (28)	140

OUO1022,0000002 –19–07JUL05–1/1

Repair Alternator

There are no serviceable parts for the alternator available from John Deere. Replace alternator as required. (Refer to machine technical manual for removal and installation.) If alternator pulley is removed, reinstall and torque pulley nut to specifications.

	Specification
Alternator Pulley Nut—Torque	95—108 N•m (70—80 lb-ft)

OUO1004,0000B35 –19–11SEP00–1/1

Charging System Failure

Causes of Charging System Failure:

- Charging system malfunction is identified by battery condition.

Undercharged batteries caused by one or a combination of the following:

- Loose belts; corroded, broken, loose, or dirty terminals; broken wiring; undersize wiring; defective batteries.
- Alternator field circuit malfunction caused by one or a combination of the following:
  - – Poor contacts between regulator and brushes.
  - – Defective diode trio.
  - – No residual magnetism in rotor.
  - – Defective or improperly adjusted regulator.
  - – Damaged or worn brushes.
  - – Damaged or worn slip rings.
  - – Poor connection between slip ring assembly and field coil leads.
  - – Rotor coil shorted, open, or grounded.
- Alternator generating section malfunction caused by one or a combination of the following:
  - – Stator phase(s) shorted, open, or grounded.
  - – Rectifier assembly grounded.
  - – Rectifier(s) shorted or open.

Overcharged batteries caused by one or a combination of the following:

- Defective battery.
- Defective diode trio.
- Defective or improperly adjusted regulator.
- Poor sensing lead contact to regulator or rectifier assembly.

45
10
2

OUO1004,0000B3D –19–13SEP00–1/1

Alternator Troubleshooting

NOTE: For fast and accurate troubleshooting, ensure that belts are properly tensioned, and that wiring and terminals are in good working condition. Check batteries per manufacturer's specifications to establish if they are defective. Ensure that batteries are 95—100% charged.

OUO1004,0000B3E –19–13SEP00–1/1

Alternator Output Test

1. Shut off all electrical accessories and run engine at approximately 1000—1200 rpm.

IMPORTANT: Use an accurate voltmeter to measure output voltage. DO NOT rely on dashboard gauges.

2. Connect a DC voltmeter to the battery terminals and measure voltage. Make a note of the readings, Compare to the values specified by the vehicle manufacturer. If reading is above specified voltage, an OVERCHARGE condition is present.

3. If the reading is below specified voltage, an UNDERCHARGE condition is present.

If either condition is observed, perform DIODE TRIO TEST in this group.

NOTE: The following tests are designed to identify the source of alternator failure. Refer to the manufacturer's service manual for detailed descriptions on how to disassemble, test, and properly assemble the alternator. No repair parts are available from John Deere. Only replacement alternators are available.

OUO1004,0000B3F –19–13SEP00–1/1

45
10
3

Diode Trio Test

1. Remove the diode trio from the alternator.
2. Connect the negative (—) ohmmeter test lead to the diode trio lead terminal. Connect the positive (+) test lead to each of the three copper contact pads, one at a time. Observe the resistance at each contact pad and write down the resistance for each contact for later reference.
3. Reverse the leads so the positive (+) lead is connected to the diode trio lead terminal and the negative (—) test lead connects to the contact pads. Again observe the resistance at each of the contact pads and record the results for each contact.

NOTE: The diode trio is OK when a LOW resistance reading is observed in one direction and a HIGH resistance is observed in the other direction. Occasionally the diode trio malfunctions under operating conditions only.

4. If the diode trio is malfunctioning, replace alternator. Otherwise, reinstall the diode trio on the alternator.

NOTE: There are no serviceable parts available from John Deere. Replacement of entire alternator is necessary if failure is detected.

OUO1004,0000B40 –19–13SEP00–1/1

45
10
4

Full Field Test

1. Run engine at approximately 1000 rpm with all electrical accessories OFF. Measure the output voltage across the alternator terminals (C and D) and write it down for later reference.

NOTE: Use a digital voltmeter with 0.01-volt reading capabilities.

2. Attach a short jumper to a 51 mm (2 in.) piece of stiff wire (a paper clip is suitable).

3. Connect the other end of the jumper to the negative (—) alternator output terminal (D) and insert the wire in the full field access hole (B). Hold the wire firmly against the brush terminal inside the housing.

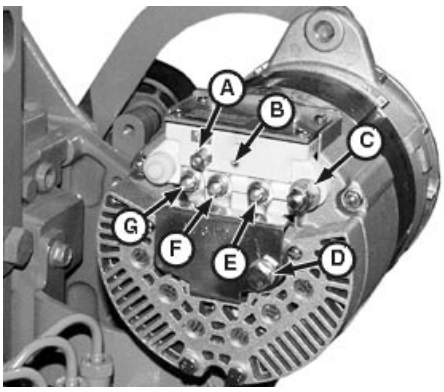
4. With the jumper in place, connect a voltmeter across the alternator terminals (C and D) and run the engine at approximately 1000 rpm. Compare this voltage reading with the voltage reading obtained in Step 1.

5. With the jumper still hooked up and the wire in the FULL FIELD ACCESS HOLE, connect an AC voltmeter across terminals 1 and 2 (G and F), 1 and 3 (G and E), and 2 and 3 (F and E), and note the voltages. If all of the voltages are approximately the same, they are considered “balanced.”

6. Remove the jumper and wire from the alternator. If the voltage in step 4 is higher than the voltage in step 1, and the voltages measured in step 5 are balanced, the stator and alternator are OK.

   If the voltage in step 4 is higher than the voltage in step 1, and the voltages measured in step 5 are not balanced, the alternator stator or rectifier(s) are defective. Replace alternator.

   If the voltage in step 4 is lower or equal to the voltage in step 1, and the voltages measured in step 5 are balanced, the alternator is defective. Replace alternator.



RG11157A –UN–13SEP00

Test Alternator

A—Ignition Terminal
B—Full Field Access Hole
C—Positive Battery Terminal
D—Negative Output Terminal
E—Terminal 3
F—Terminal 2
G—Terminal 1

45
10
5

Continued on next page

If the voltage in step 4 is lower or equal to the voltage in step 1, and the voltages measured in step 5 are not balanced, alternator stator or rectifier(s) are defective. Replace alternator.

OUO1004,0000B38 –19–12SEP00–2/2

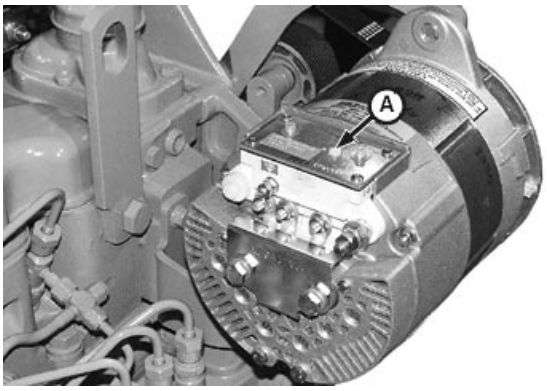
Adjust Regulator

NOTE: Battery must be at least 95% charged prior to performing this procedure. Also, make sure wire connections and belt tension are OK.

1. Shut off all electrical accessories and run the engine at approximately 1000 rpm.
2. Connect a voltmeter across alternator terminals.
3. Remove plastic screw (A) from regulator and insert a small screwdriver through hole to engage in slotted adjustment screw inside regulator.

IMPORTANT: The adjustment potentiometer screw has high and low stops. DO NOT exert excessive pressure and force the screwdriver past the stops.

4. Turn the adjustment screw clockwise to raise the voltage or counterclockwise to lower the voltage. Set alternator voltage to vehicle specifications.
5. Reinstall plastic screw (A) in regulator.



RG11156A –UN–13SEP00

Adjust Regulator

A—Plastic Screw

OUO1004,0000B37 –19–11SEP00–1/1

45
10
6

Section 50
Prestolite Alternators

Contents

Alternator Operation

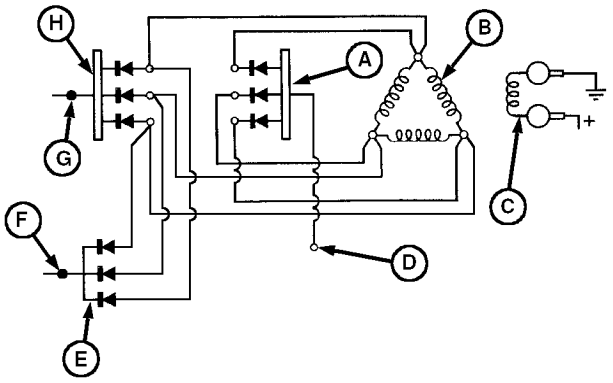
The alternator converts mechanical and magnetic energy to AC current and voltage by the rotation of an electromagnetic field/rotor (C) inside a three-phase stator assembly (B). The AC current and voltage are changed to DC by a three-phase, full-wave rectifier assembly using negative and positive diodes (A and H).

Since diodes pass current in only one direction, their arrangement in the alternator eliminates the need for a cut-out relay in the voltage regulator. The individual rectifier diodes, three positive (H) and three negative (A), are assembled in two temperature dissipating heat sinks. The heat sinks are placed in the alternator with threaded studs that also serve as circuit terminals.

Maximum charging current is limited by the design and connections in the stator assembly, eliminating the need for a current regulating relay in the voltage regulator.

The diode trio (E) is a low-current version of the rectifier assembly and must be of the same polarity. The diode trio allows for the use of a charging lamp and prevents battery drain when the charging system is not in operation.

The voltage regulator is an electronic switching device which senses the system voltage level at regulator terminal (F) and switches the voltage applied to the field in order to maintain proper system voltage.



RG11160 –UN–18SEP00

Alternator Operation

A—Negative Diode Assembly
B—Stator
C—Rotor
D—Negative Output
E—Diode Trio
F—Regulator Terminal
G—Positive Output
H—Positive Diode Assembly

OUO1004,0000B43 –19–14SEP00–1/1

50
05
1

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B8D –19–08MAY02–1/3

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

OUO1004,0000B8D –19–08MAY02–2/3

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000B8D –19–08MAY02–3/3

50
10
1

Prestolite Charging Circuit Test Specifications

John Deere alternator Part No.	Prestolite Alternator Part No.	Volts	Rated Amps
AH148633	8SC2020Z	12	185
AH211398		12	185
AT103344	8EM2009NB	12	65
AT178902	8MR2084KS	12	51
RE20486	70D43198S, 85AZ2035V	12	130
RE50811	8MR2069T, 70D43841T, 70D43841T02	12	90
RE522329	A0014730LC	24 (28)	140

OUO1022,0000001 –19–07JUL05–1/1

Repair Alternator

There are no serviceable parts from John Deere available for this alternator. Replace alternator as required.

Tighten pulley nut to specifications.

Specification	
Alternator Pulley Nut—Torque	80 N•m (59 lb-ft)

OUO1004,0000B42 –19–07JUL05–1/1

50
10
2

Charging System Failure

Causes of Charging System Failure:

- Charging system malfunction is identified by battery condition.

Undercharged batteries caused by one or a combination of the following:

- Loose belts; corroded, broken, loose, or dirty terminals; broken wiring; undersize wiring; defective batteries.
- Alternator field circuit malfunction caused by one or a combination of the following:
  - – Poor contacts between regulator and brushes.
  - – Defective diode trio.
  - – No residual magnetism in rotor.
  - – Defective or improperly adjusted regulator.
  - – Damaged or worn brushes.
  - – Damaged or worn slip rings.
  - – Poor connection between slip ring assembly and field coil leads.
  - – Rotor coil shorted, open, or grounded.
- Alternator generating section malfunction caused by one or a combination of the following:
  - – Stator phase(s) shorted, open, or grounded.
  - – Rectifier assembly grounded.
  - – Rectifier(s) shorted or open.

Overcharged batteries caused by one or a combination of the following:

- Defective battery.
- Defective diode trio.
- Defective or improperly adjusted regulator.
- Poor sensing lead contact to regulator or rectifier assembly.

OUO1004,0000B3D –19–13SEP00–1/1

Alternator Troubleshooting

NOTE: For fast and accurate troubleshooting, ensure that belts are properly tensioned, and that wiring and terminals are in good working condition. Check batteries per manufacturer's specifications to establish if they are defective. Ensure that batteries are 95—100% charged.

OUO1004,0000B3E –19–13SEP00–1/1

50
10
3

Test Alternator

Alternator Output Test

NOTE: Ensure that belts are properly tensioned, and that wiring and terminals are in good working condition. Check batteries per manufacturer's specifications to establish if they are defective. Ensure that batteries are 95—100% charged.

IMPORTANT: Use an accurate voltmeter to measure output voltage. DO NOT rely on dashboard gauges.

1. Start and run engine at approximately 1000 rpm. Turn on vehicle headlights and blower fan (low speed). Check system voltage by connecting voltmeter to output terminal (G) and negative battery post. Compare reading to the values specified by the vehicle manufacturer.

2. If alternator voltage does not fall within the specified range, replace alternator.

Diode Trio Test (MR Series Alternator)

1. Check for battery voltage at output terminal (G) and for 1.5—3 volts at regulator terminal (C).

2. Install jumper wire (H) between terminals (C and G).

3. Operate engine at low idle with all electrical accessories OFF.

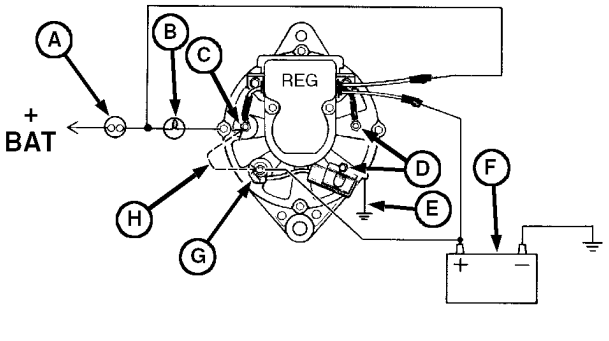
4. If charging lamp (B) is off and charging voltage is present at output terminal (G), the diode trio is probably open (defective). Replace alternator.

Field Diode Test (SC Series Alternators)

1. Check for battery voltage at output terminal.

2. Install jumper wire between alternator positive output terminal and indicator lamp terminal.

3. Operate engine at low idle with all electrical accessories OFF.



Typical Alternator Configuration

A—Ignition Switch
B—Charging Lamp
C—Regulator Terminal
D—Negative Terminals
E—Ground
F—Battery
G—Positive Output Terminal
H—Jumper Wire (Use Only for Diode Trio Test)

Continued on next page

4. Connect voltmeter to positive and negative output terminals on alternator.

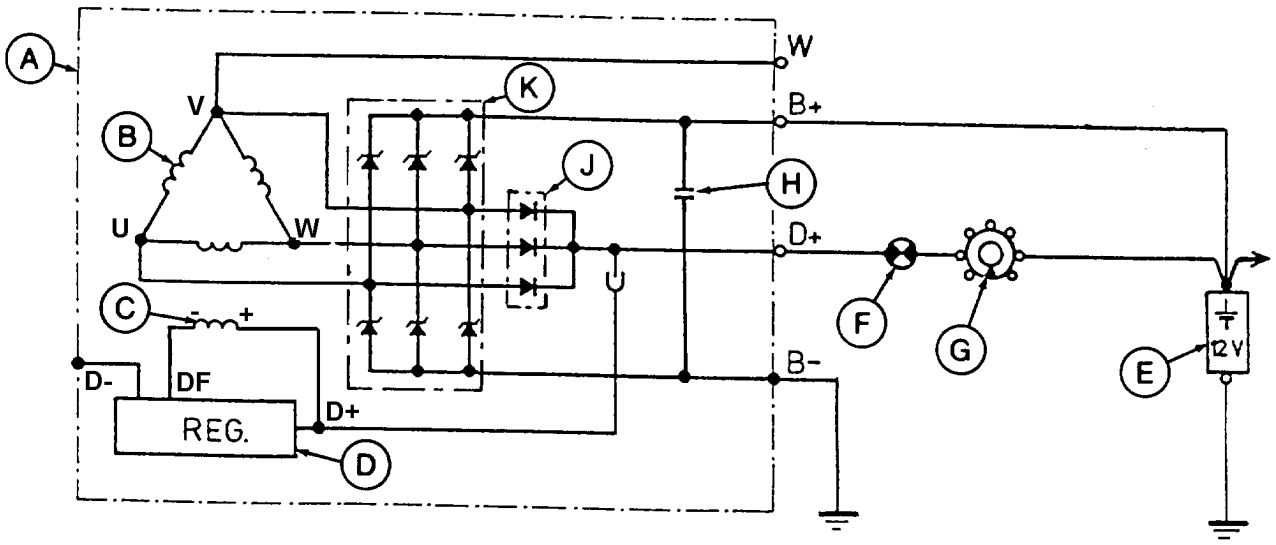
5. If alternator output is 13.5—14.1 volts, the field diode assembly is defective. Replace alternator.

OUO1004,0000B46 –19–12SEP02–2/2

Section 55
Iskra Alternators

Contents

Operation of Alternator



RG12225 –UN–29JUL02

Iskra Alternator

A—Alternator
B—Current Coil (Stator)
C—Exciting Coil (Rotor)
D—Regulator
E—Battery
F—Indicator Light
G—Ignition
H—RFI Suppression Device
J—Diode Trio
K—Rectifier Diode Bridge

The Iskra alternator is a synchronous three-phase generator. The current coils are located in the stator. Alternator is self-excited through diode trio (J), brushes and slip rings, to the exciting coil in the rotor, regulator, negative pole of the alternator (ground), and back to the stator (current) coils (B).

The alternator is normally driven by the fan belt from the engine crankshaft. The rotor is supported by two permanently lubricated bearings.

The alternator generates alternating current which is then transformed into direct current by the rectifier diode bridge (K).

The stator windings are delta-connected. The coil ends U, V and W are connected to the rectifier diode bridge as shown. Alternating current is generated in each stator coil (B) of the alternator. During one revolution of the rotor (C), the voltage in the stator coil rises from 0 to the positive maximum, drops to 0, rises to the negative maximum and again drops to 0 per one rotor pole pair. The current then flows through the diode and terminal B+ directly to the positive pole of the battery.

A sealed electronic regulator is used to regulate alternator voltage. This regulator, which cannot be adjusted, regulates the alternator voltage to approximately 14.5 volts.

A capacitor (H), suppresses radio interference.

OUOD006,0000038 –19–19JUN02–1/1

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B88 –19–19JUN02–1/3

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUO1004,0000B88 –19–19JUN02–2/3

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000B88 –19–19JUN02–3/3

Iskra Charging Circuit Repair Specifications

55
10
2

Item	Measurement	Specification
Brush	Minimum Exposed Length	1 mm (0.04 in.)
Rectifier Bridge-to-Rear Housing Bolts	Torque	2.9—4.1 N•m (26—36 lb-in.)
Capacitor Mounting Stud	Torque	2.9—4.1 N•m (26—36 lb-in.)
B+ Terminal Nut (65 amp)	Torque	4.2—6.0 N•m (37—53 lb-in.)
B+ Terminal Nut (75 amp)	Torque	9.8—14.0 N•m (87—124 lb-in.)
“W” Terminal Nut	Torque	2.7—4.1 N•m (24—36 lb-in.)
Front-to-Rear Housing Bolts	Torque	4.2—6.0 N•m (37—53 lb-in.)
Alternator Pulley Nut	Torque	60—70 N•m (44—52 lb-ft)

OUOD006,000003A –19–19JUN02–1/1

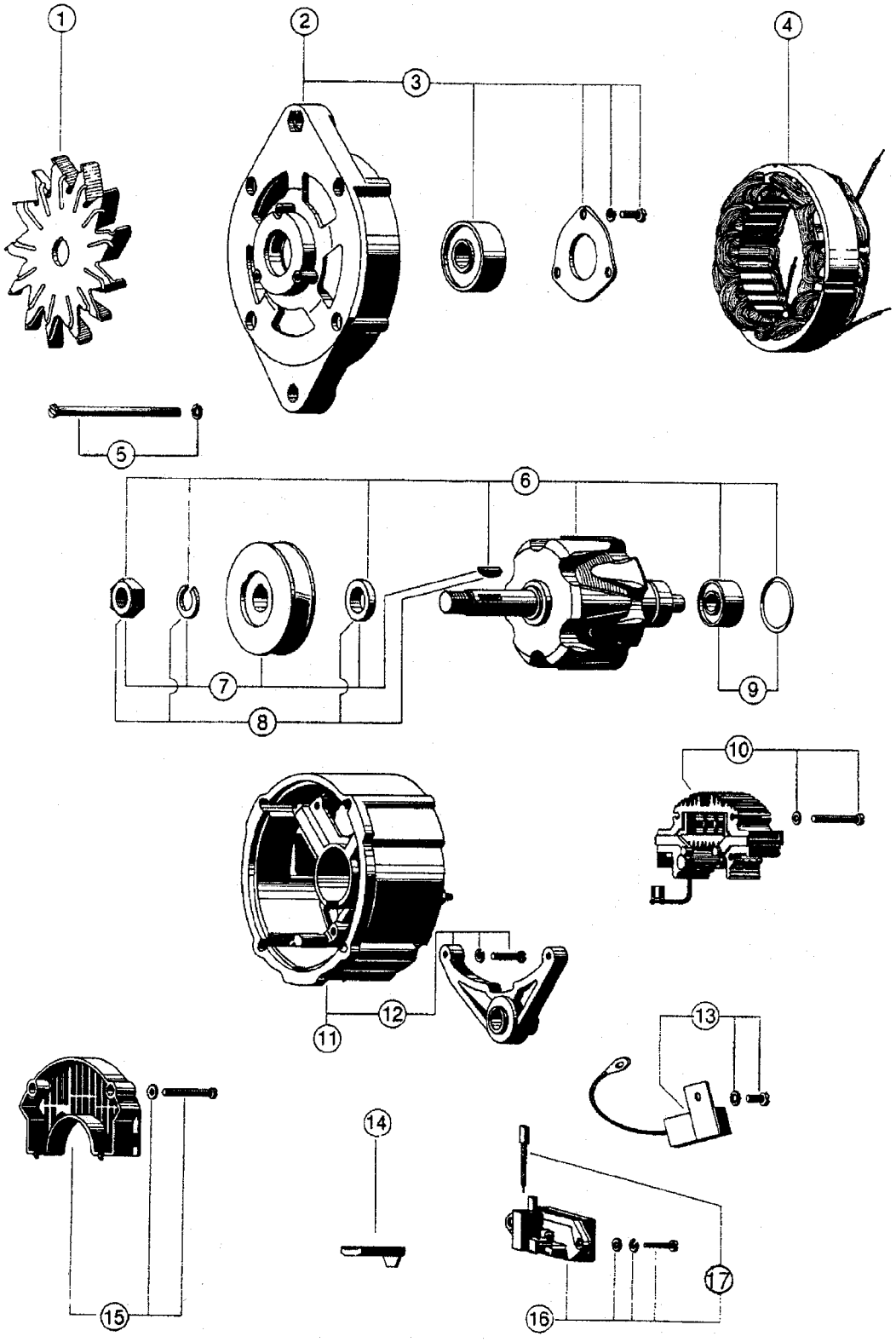
Iskra Charging Circuit Test Specifications

John Deere Alternator Part No.	Iskra Alternator Model No.	Iskra Alternator Part No.	Rated Amps	Nominal Voltage	Nominal Alternator rpm	Pulley Grooves
RE505690	AAK4335	11.203.369	50	28	6000	8
RE505895	AAK3307	11.201.869	75	14	6000	8
RE505896	AAK5378	11.203.159	95	14	6000	8
RE509106	AAK3359	11.201.998	65	14	6000	1
RE525689	AAK4334	11.203.368	75	14	6000	8
RE505896A	AAK5123	11.201.727	95	14	6000	
69X56702A	AAK3360	11.203.002	65	14	6000	
RE204426	AAK5382	11.203.167	95	14	6000	
—	AAK3394	11.203.202	95	14	6000	
RE523953A	AAK3395	11.203.203	120	14	6000	
RE522401	AAK5532	11.203.278	50	28	6000	

Item	Specification
Rotor winding resistance	2.70—2.97 ohms
Stator resistance (Phase resistance)	160—180 milliohms (65 amp); 101—111 milliohms (75 amp)
Alternator output voltage	14.3—14.6 volts (20°C), 0.5 l max, 0.5 n max)
Working temperature range	-40°C—+110°C
Maximum D+ terminal current load	0.5 amp
Maximum continuous alternator speed	13000 rpm

OUOD006,000003B –19–07JUL05–1/1

Exploded View of Alternator



Alternator—Exploded View

Continued on next page

1—Fan
2—Drive End Housing
3—Bearing With Cover
4—Stator
5—Through Bolt
6—Rotor
7—Pulley
8—Pulley Kit[1]
9—Ball Bearing
10—Rectifier
11—Rear End Housing
12—Fixing Lug
13—Capacitor
14—Gasket
15—Protective Cover
16—Regulator/Brush Holder[1]
17—Brush[1]

[1] Available as service parts.

OUOD006,000003C –19–19JUN02–2/2

Identification

The information for parts identification is provided on the label attached to the body of the alternator.

RG12226 –UN–26JUN02

Parts Identification

OUOD006,000003D –19–19JUN02–1/1

Troubleshooting

55
10
6

Symptom	Problem	Solution
Alternator indicator light stays off with ignition on and engine not running.	Loose/bad connection	Check
	Bad indicator light	Replace indicator light
	Discharged/defective battery	Charge/replace battery
	Regulator failure	Replace brush/regulator assembly
	Open rotor (exciting) circuit	Replace alternator
	Rectifier failure (breakdown of power diode)	Replace alternator
Alternator indicator light stays on with engine running at high speed (alternator is not charging).	Drive belt loose or broken	Adjust tension or replace
	Loose connection	Check
	Brush/regulator failure	Replace brush/regulator assembly
	Grounded conductor D+	Replace alternator
	Defective rectifier bridge/short circuited conductor DF or rotor winding	Replace alternator
Alternator indicator light glows brightly with engine not running, and glows dimly with engine running.	Excessive resistance in power circuit or conductors	Check conductors and power circuit
	Regulator failure	Replace regulator/brush assembly
	Alternator failure	Replace alternator

Continued on next page

OUOD006,000003E –19–19JUN02–1/2

Symptom	Problem	Solution
Discharged battery	Loose drive belt	Tension belt properly
	Open or high resistance in power circuit	Check circuit
	Defective battery	Replace battery
	Defective regulator	Replace regulator/brush assembly
	Defective alternator	Replace alternator

OUOD006,000003E –19–19JUN02–2/2

Remove and Install Pulley

1. Remove pulley nut (A), washer(s) and pulley from shaft.
2. Install pulley, washer(s) and pulley nut. Tighten to specification.

Specification

Alternator Pulley Nut—Torque ..... 60—70 N•m (44—52 lb-ft)

A—Pulley Nut

RG12227 –UN–26JUN02

Remove Pulley Nut

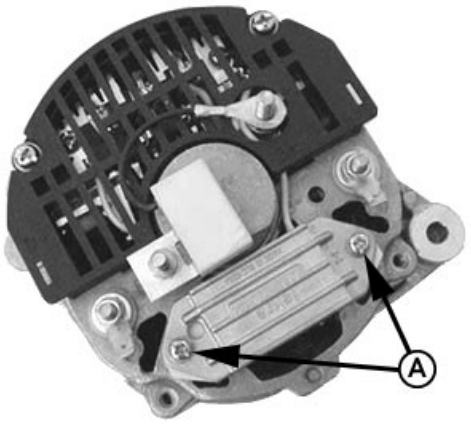
OUOD006,000003F –19–19JUN02–1/1

Testing Brush/Regulator Assembly

55
10
8

1. Remove screws (A). Remove brush/regulator assembly from rear end housing.

A—Screws (2 used)



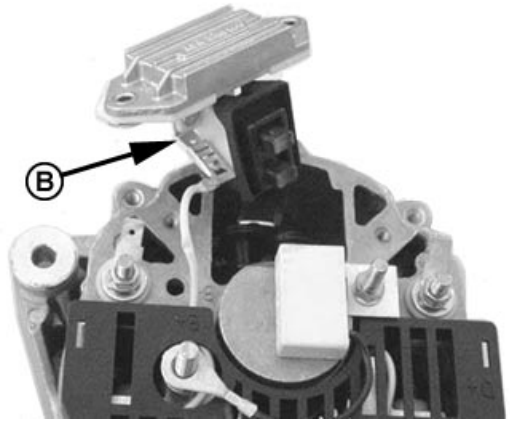
RG12228 –UN–26JUN02

Remove Brush/Regulator Assembly

OUOD006,0000040 –19–19JUN02–1/4

2. Remove wire from terminal (B).

B—Terminal



RG12229 –UN–26JUN02

Remove Wire

Continued on next page

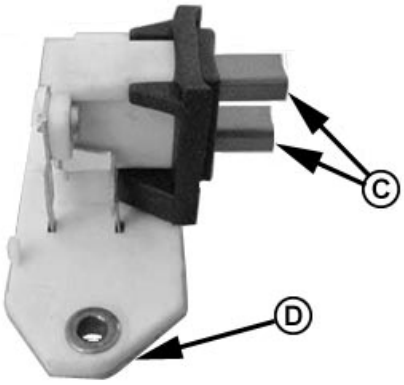
OUOD006,0000040 –19–19JUN02–2/4

3. Check brushes (C) mounted on brush holder (D) for free movement against spring tension. If either brush is worn beyond specification, replace the brush/regulator assembly. Also replace if the brushes are cracked or oil-soaked.

Specification

Brush—Minimum Exposed Length..... 1 mm (0.04 in.)

C—Brushes
D—Brush Holder



RG12230 –UN–26JUN02

Check Brushes

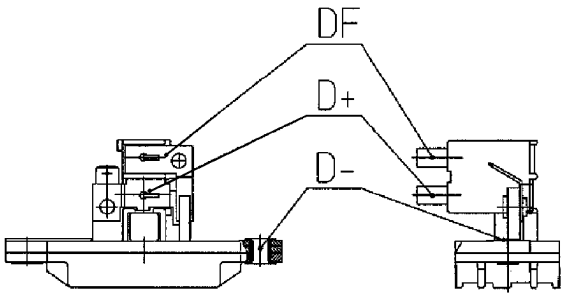
OUOD006,0000040 –19–19JUN02–3/4

4. To test voltage regulation of regulator, identify terminals using top diagram on right, and make connections as shown in bottom diagram.

5. Increase rectifier voltage.

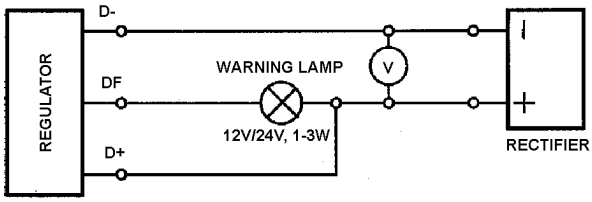
   Lamp in circuit should glow when rectifier voltage is below 14.3V +/- 0.5V, and go out when rectifier voltage is 14.3V +/- 0.5V.

   If lamp does not glow at all, or does not go out when voltage is 14.3V +/- 0.5V, regulator is defective and must be replaced.



RG12494 –UN–29JUL02

Terminal Identification



RG12495 –19–18JUL02

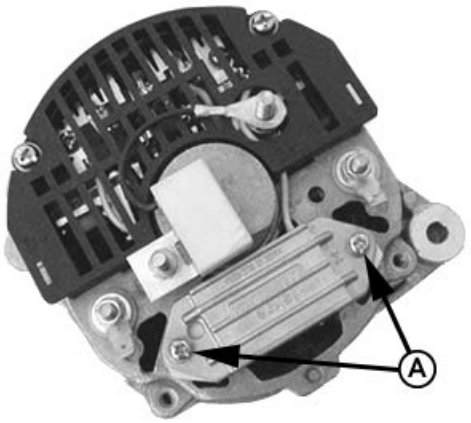
Connections

OUOD006,0000040 –19–19JUN02–4/4

Install Brush/Regulator Assembly

1. Attach wire to terminal. Install brush/regulator assembly with caution. Fasten brush/regulator with the two screws (A) and washers.

A—Screws (2 Used)



RG12228 –UN–26JUN02

Install Brush/Regulator Assembly

OUOD006,0000041 –19–19JUN02–1/1

Installation of Alternator

Refer to machine technical manual to install alternator and to adjust belt tension.

RG,RG34710,2191 –19–15MAR97–1/1

Section 60
Delco-Remy Starter Motors

Contents

Continued on next page

Page

General Information

IMPORTANT: Never operate starter motor longer than 30 seconds. Allow at least 2 minutes for cooling and battery recovery before operating again. Overheating caused by excessive operation will seriously damage starter motor.

RG,RG34710,2192 –19–15MAR97–1/1

Typical Starting Circuit Operation

When wire from relay (A) is energized, current flows through both pull-in winding (C) and hold-in winding (D) to ground.

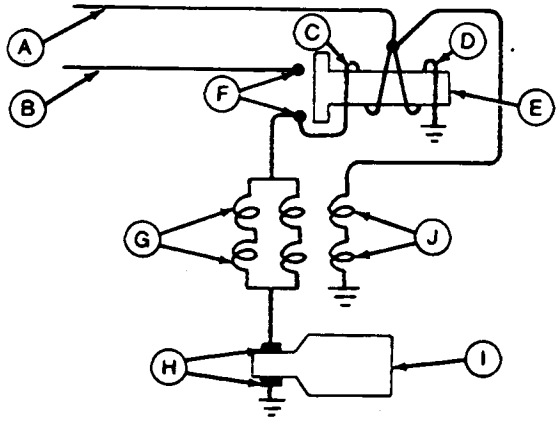
Current through windings engages solenoid plunger (E), which closes main contacts (F). When main contacts close, current through pull-in windings stops. Current continues through hold-in winding, keeping solenoid engaged and main contacts closed.

With main contacts closed, current flows from battery cable (B) to starter motor at a very high rate. Four heavy field windings (G) carry current to commutator brushes (H).

Light shunt windings (J) are wrapped together with two of the heavy field windings. Shunt windings are connected to solenoid switch terminal and directly to ground. They provide additional low speed torque to assist engine rotation and prevent overheating of motor.

From field windings, current flows through armature windings (I) to ground, making contact through commutator brushes (H).

Strong magnetic fields are set up by current flow through field windings and armature windings. Windings are arranged so that magnetic fields constantly repel each other, rotating armature.



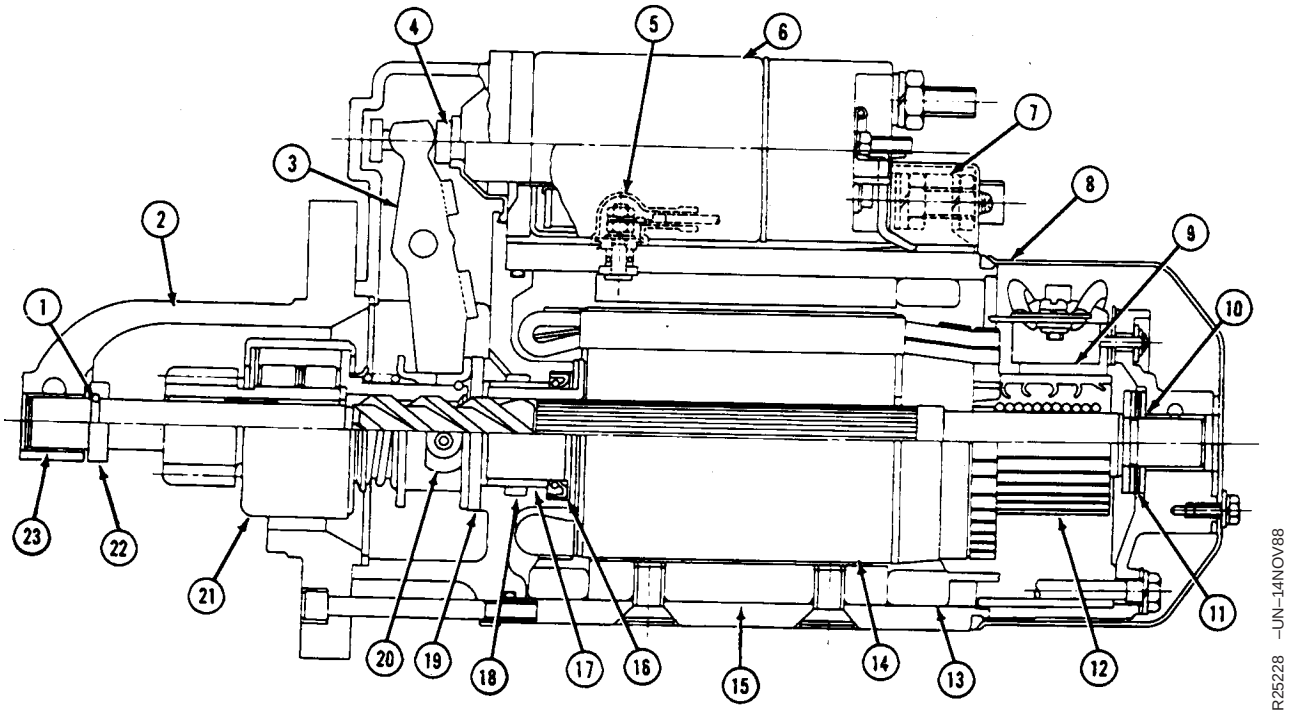
RG1313 –UN–20APR89

Typical Starting Circuit Operation

A—Wire from Relay
B—Cable from Battery
C—Pull-In Winding
D—Hold-In Winding
E—Solenoid Plunger
F—Main Contacts
G—Field Windings
H—Commutator Brushes
I—Armature
J—Shunt Windings

RG,RG34710,2193 –19–09OCT00–1/1

Typical Starter Motor Operation



Typical Starter Motor Operation

1—Snap Ring
2—Drive End Housing
3—Shift Lever
4—Plunger
5—Shunt Field Terminal
6—Solenoid Assembly
7—Field Connector
8—End Frame Cover
9—Brush
10—Bushing
11—Thrust Washers
12—Commutator
13—Field Windings
14—Armature
15—Pole Shoe
16—Oil Seal
17—Bushing
18—Felt
19—Brake Washer
20—Wear Pads
21—Overrunning Clutch
22—Pinion Stop
23—Bushing

When solenoid (6) engages, it pulls shift lever (3). Shift lever pushes overrunning clutch drive (21) to engage pinion in starter gear on flywheel. As armature (14) turns, it cranks engine.

When engine starts, overrunning clutch spins freely on shaft. This prevents overspeeding of armature by flywheel.

When key switch is released, current to solenoid hold-in winding is shut off. Current can feed through both pull-in and hold-in windings from main contacts, but direction of current is reversed in pull-in winding. The two windings cancel each other, and solenoid is released.

A spring pushes solenoid back to disengaged position. This opens main contacts and shuts off current to field windings and armature.

Shift lever retracts overrunning clutch drive, disengaging pinion from flywheel. Brake washer (19) slows armature to a stop.

RG,RG34710,2194 –19–15MAR97–1/1

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B8F –19–08MAY02–1/3

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUO1004,0000B8F –19–08MAY02–2/3

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000B8F –19–08MAY02–3/3

Service Equipment and Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC). Some tools may be available from a local supplier.

60
10
2

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B90 –19–25SEP00–1/2

Bushing, Bearing, and Seal Driver Set. D01045AA

Remove and install all commutator, drive end, and center bushings and/or bearings.

OUO1004,0000B90 –19–25SEP00–2/2

Other Material

Number	Name	Use
	Mineral Spirits	Clean armature, solenoid and brushes.
	00 Sandpaper	Clean commutator.

OUO1004,0000B91 –19–25SEP00–1/1

Delco-Remy 10MT, 20MT, 22MT, 25MT, 27MT, 28MT Starter Motor Repair Specifications

Item	Measurement	Specification
Brush Spring	Minimum Tension	990 gram force (35 ounce-force)
Brushes	Minimum Length Beyond Holder	7.9 mm (0.31 in.)
Field Pole Shoe Screws	Torque	41 N•m (30 lb-ft)
Solenoid “R” Terminal Contact	Height	1.59—2.38 mm (0.062—0.093 in.)
New Drive End Housing Bushing	ID	11.709—11.811 mm (0.4610—0.4650 in.)
	Wear Limit	12.065 mm (0.475 in.)
	Oil Clearance	0.051—0.127 mm (0.0020—0.0050 in.)
	Wear Limit	0.432 mm (0.0170 in.)
Motor Drive	ID	14.275—14.300 mm (0.5620—0.5630 in.)
	Wear Limit	14.579 mm (0.5740 in.)
New Center Bearing Plate Bushing	ID	19.304—19.354 mm (0.7600—0.7620 in.)
	Wear Limit	19.608 mm (0.7720 in.)
	Oil Clearance	0.254—0.381 mm (0.0100—0.0150 in.)
	Wear Limit	0.635 mm (0.0250 in.)
New Commutator End Frame Bushing	ID	14.313—14.338 mm (0.5635—0.5645 in.)
	Wear Limit	14.554 mm (0.5730 in.)
	Oil Clearance	0.051—0.127 mm (0.0020—0.0050 in.)
	Wear Limit	0.406 mm (0.0160 in.)
Housing Attaching Cap Screws	Torque	18—23 N•m (159—204 lb-in.)
Commutator End Frame Cap Screws	Torque	18—23 N•m (159—204 lb-in.)
Pinion-to-Pinion Stop	Clearance	0.25—3.56 mm (0.010—0.140 in.)

Delco-Remy 10MT, 20MT, 22MT, 25MT, 27MT, 28MT Starter Motor Test Specifications

NOTE: Specification data for starters marked with an asterisk (*) was not available from Delco. Data provided for these asterisked starters in the following table was obtained from the John Deere Alternator, Generator, Starter and Battery Bench Tester Operator's Manual (OMTY25323, 14Dec01). This data is for remanufactured starters, provided by suppliers other than Delco, which can be used as replacements for the Delco starters. Specifications for the remanufactured starters may not correspond exactly with the original Delco starter specifications, and should be used for reference only. Delco does not either approve nor disapprove the use of these specifications.

				No Load Test (Includes Solenoid Current)	
John Deere Starter Motor Part No.	**Delco-Remy Starter Motor Model No. -Series**	**System Voltage**	**Motor Voltage**	**Current Draw (Amps)**	**Armature RPM**
* AA6004R	1108989	12	10	85 Max	3500—5500
* AH76330	1108360-10MT	12	9 (10)	90 Max	3500—6000
* AP22652	1107972	12	9	155 Max	8000—13000
* AR11150	1103004	12	10	85 Max	3500—5500
AR11160	1109434	12	10	65—110	6500—10700
AR11161	1107547	24	23.5	60—130	4900—8500
AR60085	1109147-20MT	12	9	50—80	5500—9000
AR69750	1998364-22MT	12	10	75—175	6900—14900
AR91813	1109576-SD300	12	10	65—110	6500—10700
AT10806	1107736	12	9	50	3500—6000
AT10958	1113104	12	9	50—75	3500—5500
AT11324	1107175	6	5.6	70	5500
AT12283	1107879	12	9	55—80	3500—6000
AT12458	1108672	12	11.8	55—85	6300—8700
AT15335	1107547	24	23.5	60—130	4900—8500
AT16883	1107176	6	5.6	70	5500
AT17411	1107573	12	11.8	55—85	6300—8700
AT18025	1109421-SD300	12	10	60—90	6500—10500
AT18150	1107577-20MT	12	9	40—140	8000—13000
AT18150	1107599-20MT	12	9	40—140	8000—13000
AT18150	1107863-20MT	12	9	40—140	8000—13000

Continued on next page

				No Load Test (Includes Solenoid Current)	
John Deere Starter Motor Part No.	**Delco-Remy Starter Motor Model No. -Series**	**System Voltage**	**Motor Voltage**	**Current Draw (Amps)**	**Armature RPM**
AT18150	1107871-20MT	12	9	40—140	8000—13000
AT19196	1998364-20MT	12	10	75—175	6900—14900
AT25619	1107863-20MT	12	9	40—140	8000—13000
AT25619	1107871-20MT	12	10	75—175	8000—13000
AT418T	1107685	12	9	50—75	3500—6000
AT452T	1107713	12	9	50—75	3500—6000
RE19187	1998367-20MT	12	9	40—140	6900—14900
RE19737	1998519-20MT	24	20	40—80	8000—13700
* RE49033	1113271-28MT	12	9	180 Max	2800 (Output Gear)
RE50095	1113271-28MT	12	10	125—190	3000—5600
RE51723	1113283-28 MT	12	10	125—190	3000—5600
RE51725	1113272-28MT	24	20	75—100	3600—6300
RE52119	1113272-28MT	24	20	75—100	3600—6300
RE60654	10479628-28MT	12	10.6	135—190	3600—5600
RE62916	1113271-28MT	12	10	125—190	3000—5600
RE64647	10479630-28MT	12	10.6	135—190	3600—5600

RG,RG34710,2198 –19–07JUL05–2/2

Diagnosing Starter Motor Malfunctions

Fails to Operate, No Current Draw

Open field circuit (all field windings)

Open armature windings

Defective brush contact with commutator

Open solenoid windings

Defective solenoid contacts

Fails to Operate, High Current Draw

Grounded field windings or armature windings

Seized bearings

Low Speed, Low Current Draw

High internal resistance

Defective brush contact with commutator

Low Speed, High Current Draw

Excessive friction

Shorted armature

Grounded armature or field windings

High Speed, High Current Draw

Shorted field windings

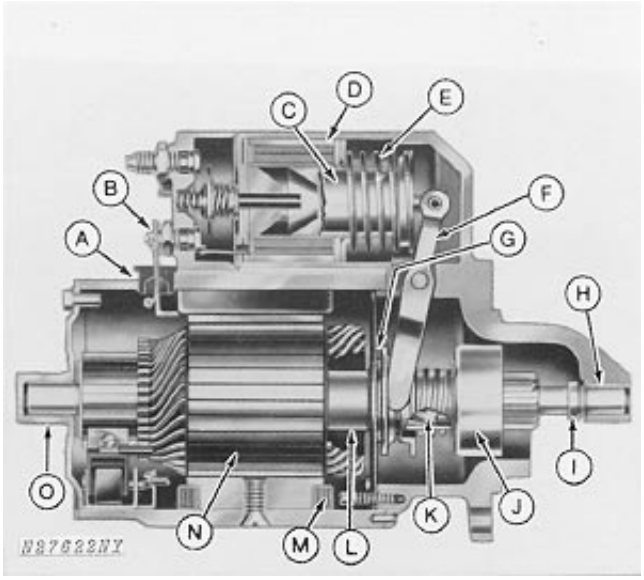
NOTE: This test will not detect individual open-circuited field coils—the stator would have a slow cranking speed but would pass this test.

RG,RG34710,2199 –19–15MAR97–1/1

Delco-Remy Starter Motor Cutaway View—Series 10MT, 20MT, 22MT, 25MT, 27MT, 28MT

IMPORTANT: Never operate starter motor more than 30 seconds. Allow at least 2 minutes for cooling and battery recovery before operating again. Overheating, caused by excessive operation, will seriously damage starter motor.

A—Grommet
B—Field Connectors
C—Plunger
D—Solenoid
E—Return Spring
F—Shift Lever
G—Brake Washer
H—Bushing
I—Pinion Stop
J—Overrunning Clutch
K—Spiral Splines
L—Center Bearing
M—Field Coil
N—Armature
O—Bushing



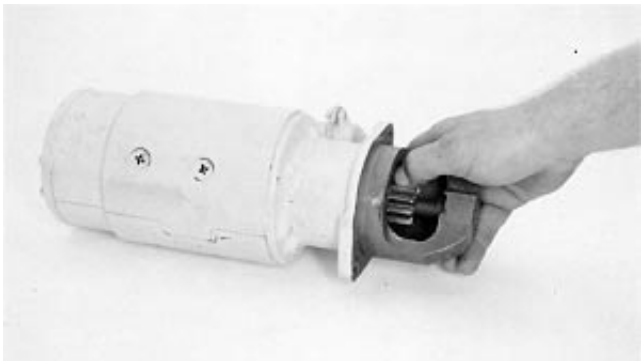
N27622 –UN–22SEP88

Series 20MT Shown

RG,RG34710,2200 –19–06MAY02–1/1

Check Operation of Motor Drive

1. Turn overrunning clutch pinion by hand. Clutch pinion should turn freely on shaft in overrunning direction only.



T81530 –UN–01NOV88

Turn Overrunning Clutch Pinion

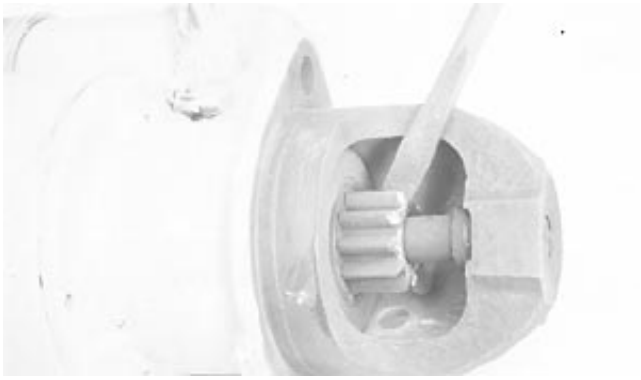
Continued on next page

RG,RG34710,2201 –19–15MAR97–1/2

2. Turn armature by prying against pinion with screwdriver. Check for dragging armature, seized bushings or bent shaft.

   If there is any interference, disassemble and repair starter motor.

NOTE: DO NOT conduct the no-load test unless armature turns freely.



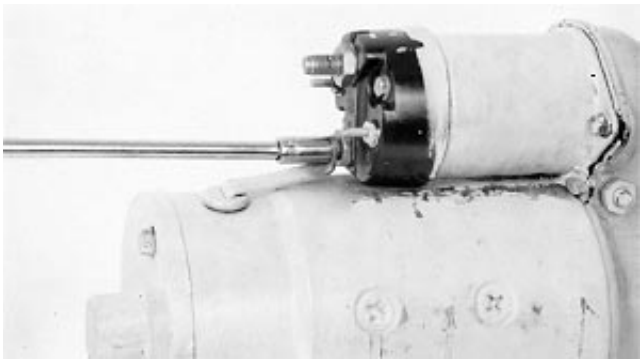
T81531 –UN–01NOV88

Turn Armature

RG,RG34710,2201 –19–15MAR97–2/2

Make Solenoid Pull-In Test

1. To prevent damage, solenoid must be on starter motor when testing the windings.
2. Disconnect field connector from solenoid “M” terminal as shown.



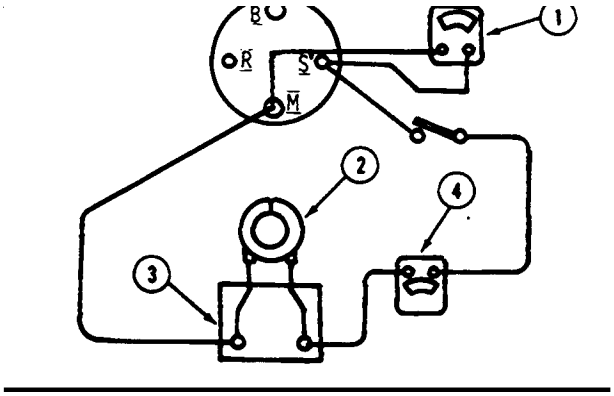
T81532 –UN–01NOV88

Disconnect Field Connector

RG,RG34710,2202 –19–15MAR97–1/2

3. Make connections as shown. Quickly adjust the carbon pile resistor to obtain 5 volts. The ammeter reading must be 13—15.5 amps.

1—Voltmeter
2—Carbon Pile Resistor
3—Battery
4—Ammeter



T81519 –UN–25MAY89

Make Connections

RG,RG34710,2202 –19–15MAR97–2/2

Make Solenoid Hold-In Test

Make connections as shown. Adjust the carbon pile resistor to obtain 10 volts. The ammeter reading should be 14.5—16.5 amps.

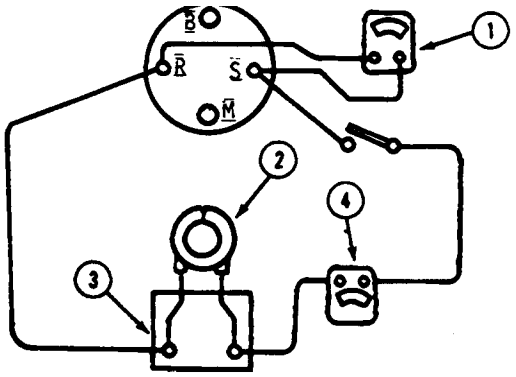
A high ammeter reading indicates windings are grounded or short circuited.

A low ammeter reading indicates excessive resistance (usually in a connection).

No ammeter reading indicates windings are open circuited.

To prevent overheating, do not energize the pull-in winding longer than 15 seconds. Current draw will decrease as the winding temperature increases.

If the fault cannot be repaired and the solenoid performance is questionable, replace the windings.



T81520 –UN–25MAY89

Make Solenoid Hold-In Test

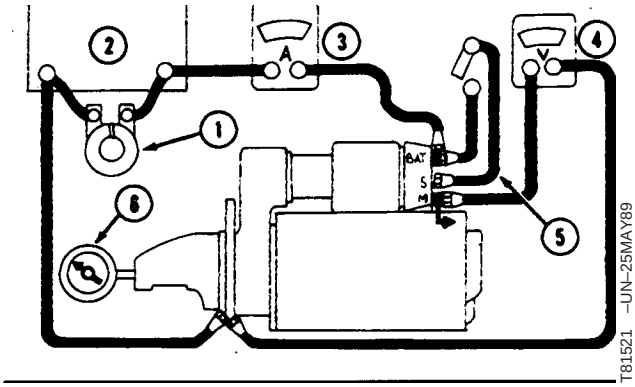
1—Voltmeter
2—Carbon Pile Resistor
3—Battery
4—Ammeter

RG,RG34710,2203 –19–15MAR97–1/1

Make Solenoid No-Load Test

1. Clamp starter motor drive housing in vise.
2. Make connections as shown.
3. Close switch to operate starter motor and adjust carbon pile resistor to obtain 9.0 volts.

   Current draw must be to specifications given at beginning of this group.



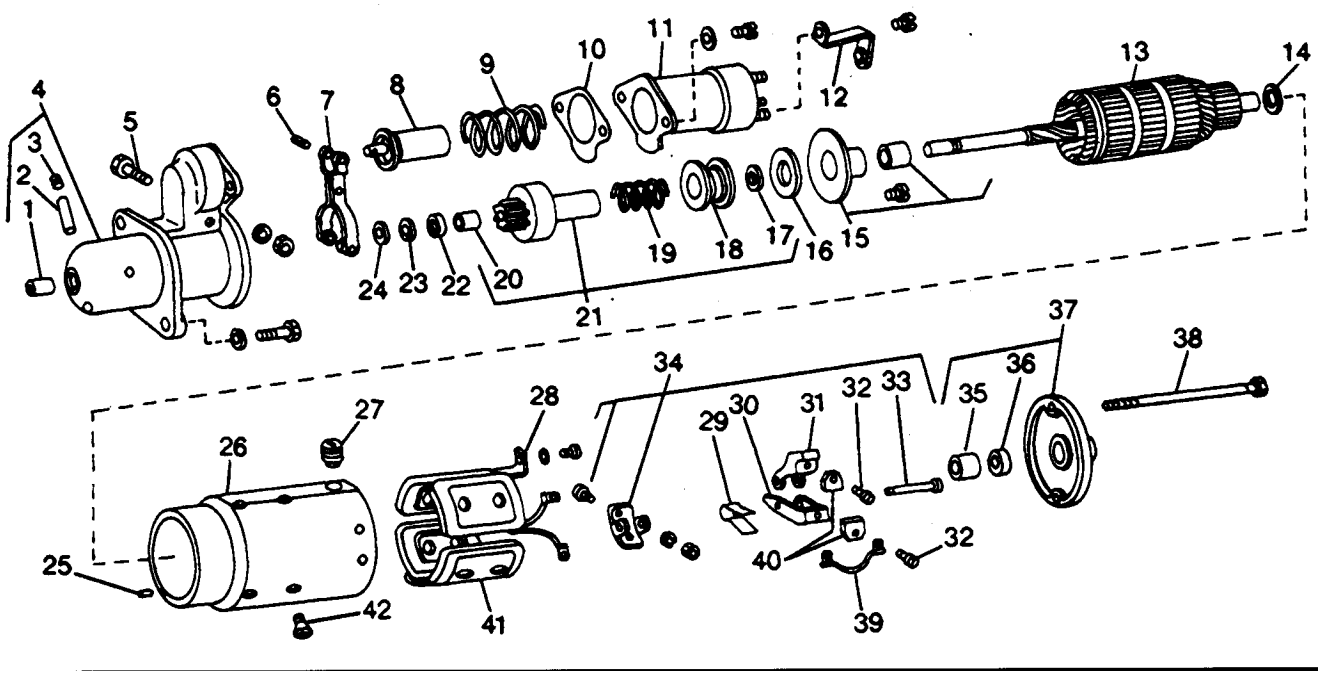
T81521 –UN–25MAY89

Make Solenoid No-Load Test

1—Carbon Pile Resistor
2—Battery
3—Ammeter
4—Voltmeter
5—Jumper Lead with Switch
6—Tachometer

DPSG,OUOE003,27 –19–17DEC98–1/1

Disassemble Starter Motor and Test Components



Delco-Remy No. 1998367 Shown

1—Bushing
2—Lubricating Wick
3—Plug
4—Drive End Housing
5—Shifter Pivot Screw
6—Spring Pin
7—Shifter
8—Solenoid Plunger
9—Solenoid Return Spring
10—Gasket
11—Solenoid Assembly
12—Field Coil Connector
13—Armature
14—Thrust Washer
15—Center Bearing Assembly
16—Brake Washer
17—Lock Wire
18—Collar
19—Overrunning Clutch Spring
20—Bushing
21—Overrunning Clutch Assembly
22—Pinion Stop
23—Snap Ring
24—Thrust Collar
25—Dowel Pin
26—Field Frame
27—Insulating Bushing
28—Field Winding Coil
29—Brush Spring (2 Used)
30—Grounded Brush Holder (2 Used)
31—Insulated Brush Holder (2 Used)
32—Brush Mounting Screws (4 Used)
33—Brush Pivot Pin (2 Used)
34—Brush Holder Kit
35—Bushing
36—Lubricating Wick
37—Commutator End Frame
38—Bolt (2 Used)
39—Brush Ground Lead (2 Used)
40—Brush (4 Used)
41—Field Pole Shoe
42—Pole Shoe Screw (8 Used)

RG,RG34710,2204 –19–15MAR97–1/11

1. Remove commutator end frame cap screws and commutator end frame.

Remove Commutator End Frame

Continued on next page

RG,RG34710,2204 –19–15MAR97–2/11

2. Disconnect field coil connector and remove field frame.

Remove Field Frame

RG,RG34710,2204 –19–15MAR97–3/11

3. Make sure brushes are not binding holders. The full brush surface must ride on commutator.

4. Check by hand to make certain brush springs are giving firm contact between brushes and commutator. If springs are distorted or discolored, replace them.

Check Brushes and Brush Springs

RG,RG34710,2204 –19–15MAR97–4/11

5. Remove brush pins, brush holders and brush springs. Check brush spring tension.

Specification

Brush Spring—Minimum Tension..... 990 gram force (35 ounce-force)

Remove Pins, Holders, and Springs

Continued on next page

RG,RG34710,2204 –19–15MAR97–5/11

6. Check brushes for being oil soaked or worn beyond specifications.

Specification

Brushes—Minimum Length
Beyond Holder ..... 7.9 mm (0.31 in.)

Measure Brushes

RG,RG34710,2204 –19–15MAR97–6/11

7. Tighten screws securely when installing new brushes.

Tighten Screws Securely

RG,RG34710,2204 –19–15MAR97–7/11

8. Remove screws, solenoid switch assembly, solenoid gasket and plunger return spring.

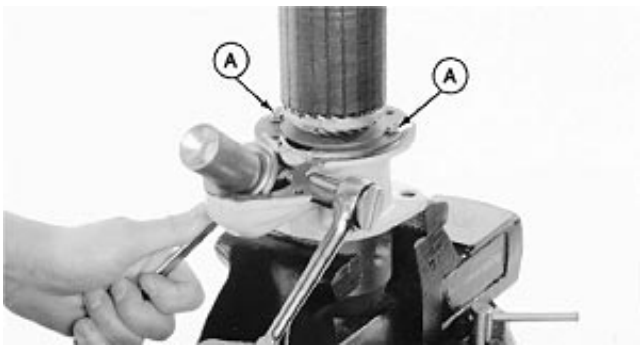
Remove Parts

RG,RG34710,2204 –19–15MAR97–8/11

9. Remove the shift lever cap screw and center bearing screws (A).

10. Remove armature.

A—Bearing Screws



Remove Armature

Continued on next page

RG,RG34710,2204 –19–15MAR97–9/11

11. Use a 1/2-in. pipe nipple or other suitable metal cylinder to drive pinion stop toward pinion.

Drive Pinion Stop

RG,RG34710,2204 –19–15MAR97–10/11

12. Remove retaining ring (A), pinion stop, and overrunning clutch drive.

13. Remove brake washer and center bearing plate (B).

A—Retaining Ring
B—Bearing Plate

Center Bearing Plate

RG,RG34710,2204 –19–15MAR97–11/11

Clean Starter Motor Components

IMPORTANT: Never clean armature, field windings, or overrunning clutch drive in solvent. All parts except overrunning clutch drive may be cleaned with mineral spirits and a brush.

1. Clean components using mineral spirits and a brush.

2. Dry with compressed air or a clean cloth.

DPSG,OUOE003,28 –19–17DEC98–1/1

Inspect Armature

1. Place armature in V-blocks and check for a bent shaft. Replace armature if shaft is bent.
2. Inspect armature for signs of dragging against pole shoes or scoring under bushings.
3. Carefully check commutator for roughness, burned commutator bars or any material that might cause short circuits between bars.
4. Clean and touch up commutator, if necessary, with 00 sandpaper. NEVER use emery cloth.

NOTE: If commutator is out of round, badly burned or rough, it can be turned down slightly on a lathe. Remove only enough metal to eliminate problem. Do not undercut commutator after turning, as this will cause shorts between commutator bars.

X1451 –UN–25JAN89

Inspect Armature

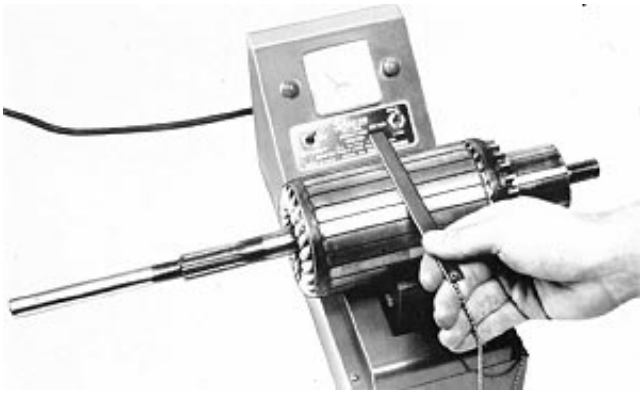
RG,RG34710,2205 –19–15MAR97–1/1

Make Short Circuit Test

Place armature in a growler and hold hacksaw blade above each slot while slowly rotating the armature.

If coil is shorted, the blade will be attracted to and repelled from the slot.

Short circuit most often occurs because of copper dust or filings between two commutator segments. Clean commutator segments to correct this short.



T81543 –UN–07DEC88

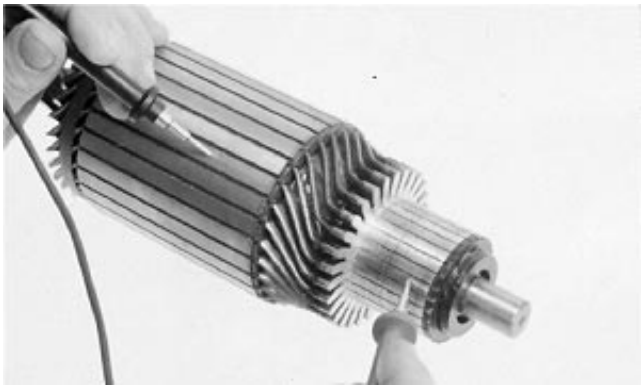
Make Short Circuit Test

RG,RG34710,2206 –19–15MAR97–1/1

Make Armature Ground Test

1. Set ohmmeter to read on highest scale.
2. Place one test lead on the armature core or shaft. Place other lead on commutator.

   If the test meter indicator swings toward zero, the armature is grounded. Replace armature.



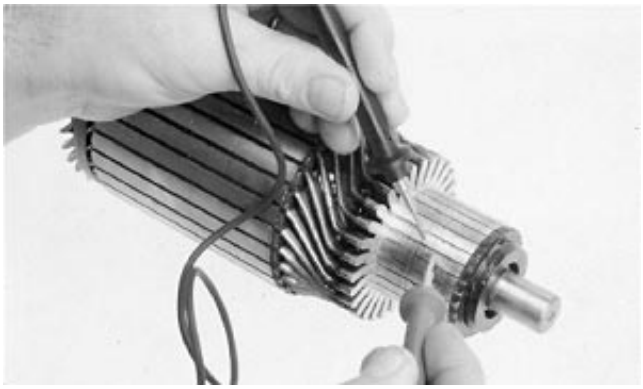
Make Armature Ground Test

RG,RG34710,2207 –19–15MAR97–1/1

Make Open Circuit Test

1. Set ohmmeter to read on lowest scale.
2. Place one test lead on commutator segment. Place other test lead on an adjacent segment.
3. Repeat this operation for all segments by moving one lead at a time.

   If the test meter indicator does not swing to zero and remain stationary, the armature coil between these two segment is open. Replace armature.



Make Open Circuit Test

RG,RG34710,2208 –19–06MAY02–1/1

Make Ground Circuit Test for Field Windings

1. Set ohmmeter to read on highest scale.
2. Connect one test lead to the field frame and the other test lead to the field connector.

   If the test meter indicator swings toward zero, the field coils are grounded. Replace the field windings.

Make Ground Circuit Test

RG,RG34710,2209 –19–15MAR97–1/1

Make Open Circuit Test for Field Windings

1. Set ohmmeter on its lowest scale.
2. Connect one test lead to a field coil lead. Connect the other test lead to the field connector.

   If the test meter indicator does not swing to zero and remains stationary, the field coils have an open circuit. Replace field coils.

Make Open Circuit Test

RG,RG34710,2210 –19–15MAR97–1/1

Remove Field Coils (If Necessary)

1. The field connector must be removed before the field coils can be removed from frame.

Remove Field Connector

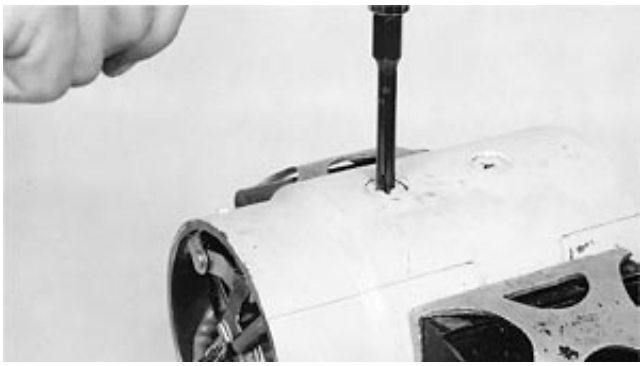
RG,RG34710,2211 –19–15MAR97–1/2

2. Place field frame in a soft-jawed vise.

IMPORTANT: Do not squeeze sides of field frame in vise or strike with a hammer. If an impact screwdriver is used to remove pole shoe screws, support each pole shoe individually using a pole shoe spreader or nose of anvil.

3. Make a scribe mark on pole shoe and field frame for proper assembly.
4. Use a large screwdriver bit and socket wrench to remove pole shoe screws.
5. Remove pole shoes. Then carefully remove field windings as an assembly.

IMPORTANT: Handle windings very carefully. Windings are easily damaged, causing shorts, opens, or grounds.



Remove Field Windings

RG,RG34710,2211 –19–15MAR97–2/2

Install Field Windings

1. Carefully insert field windings.
2. Align scribe marks on pole shoes and field frame. Assemble shoe so the long lip points in direction of armature rotation.
3. Tighten pole shoe screws to specifications. Use a center punch to lightly stake one edge of each screw.

Specification

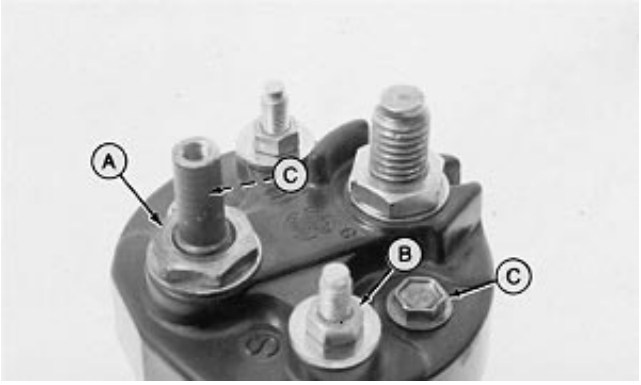
Field Pole Shoe Screws—Torque ..... 41 N•m (30 lb-ft)

RG,RG34710,2212 –19–15MAR97–1/1

Disassemble Solenoid

1. Remove hex nuts from “M” and “S” terminals (A) and (B).
2. Remove the two screws (C) and cover.

A—“M” Terminal
B—“S” Terminal
C—Cover Screws



T5966AB –UN–02APR90

Disassemble Solenoid

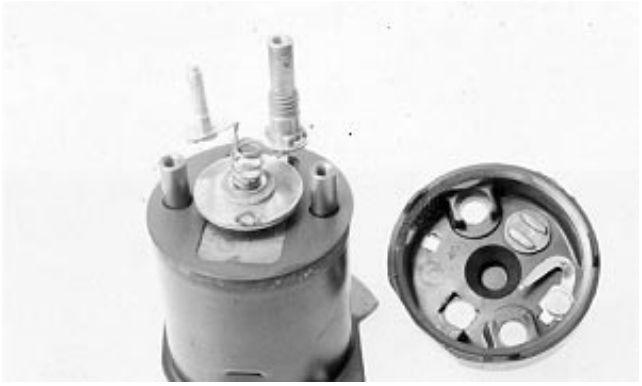
RG,RG34710,2213 –19–15MAR97–1/1

Inspect and Clean Solenoid Parts

Inspect all solenoid parts for wear, dirt, and corrosion.

Wipe all parts and connections with mineral spirits and a clean cloth or brush. Dry with a clean cloth.

Firm pressure should be felt on the plunger when fully depressed. If plunger is weak, replace solenoid winding and plunger assembly.



T5966AA –UN–11APR90

Inspect and Clean Solenoid Parts

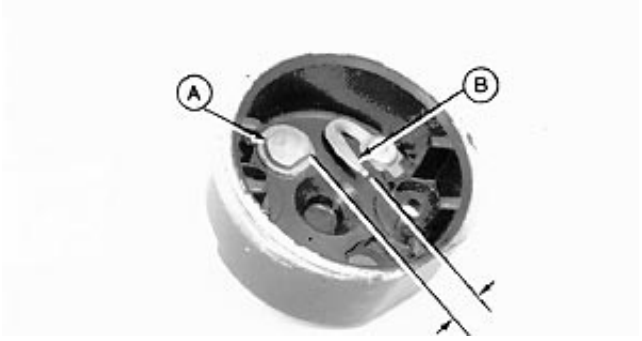
RG,RG34710,2214 –19–15MAR97–1/3

The “R” terminal contact finger (B) height above the surface of the main contact (A) must be 1.59—2.38 mm (1/16—3/32 in.). Bend contact finger if adjustment is necessary.

Specification

Solenoid “R” Terminal Contact—
Height ..... 1.59—2.38 mm (0.062—0.093 in.)

A—Main Contact
B—“R” Terminal Contact Finger



T88858 –UN–21FEB90

“R” Terminal Contact Finger

RG,RG34710,2214 –19–15MAR97–2/3

Replacement “S” terminal and “M” terminal stud clips must be crimped to winding leads.

T81553 –UN–22MAR90

Replacement Stud Clips

RG,RG34710,2214 –19–15MAR97–3/3

Assemble Solenoid

1. Place gasket on winding terminal.
2. Align main contact vertically.
3. Place packing on switch cover.
4. Tighten switch cover screws to solenoid winding and plunger assembly securely.

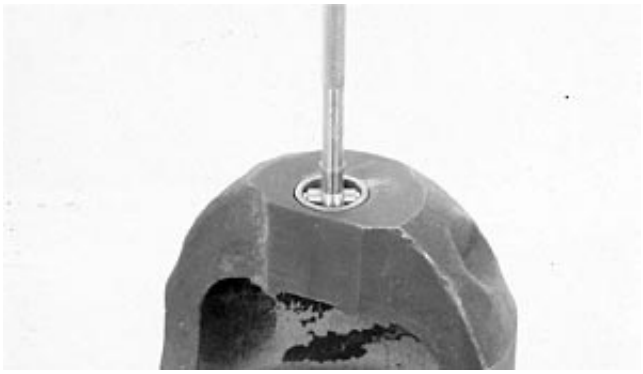
NOTE: Solenoid contacts and plunger will be damaged if current is applied to solenoid when removed from starter motor.

RG,RG34710,2215 –19–15MAR97–1/1

Remove Drive End Bushing and Wick

1. Measure drive end bushing.

Specification	
New Drive End Housing Bushing—ID	11.709—11.811 mm (0.4610—0.4650 in.)
Wear Limit	12.065 mm (0.475 in.)
Oil Clearance	0.051—0.127 mm (0.0020—0.0050 in.)
Wear Limit	0.432 mm (0.0170 in.)

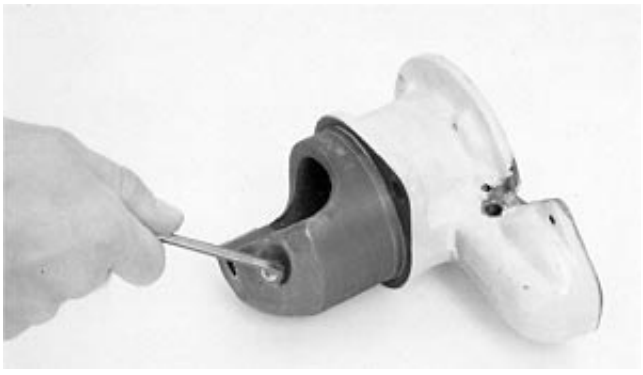


T81524 –UN–22MAR90

Measure Drive End Bushing

RG,RG34710,2216 –19–15MAR97–1/3

2. Remove plug and drive end wick.



T81556 –UN–22MAR90

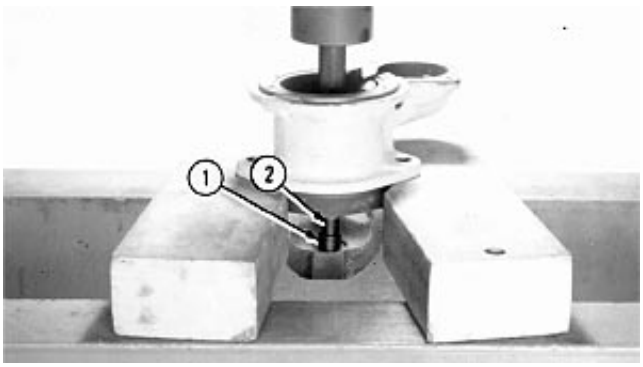
Remove Plug and Drive End Wick

Continued on next page

RG,RG34710,2216 –19–15MAR97–2/3

3. Use 27493 Disk (1) and 27491 Disk (2) from D01045AA Bushing, Bearing and Seal Driver Set to remove the drive end bushing.

1—27493 Disk
2—27491 Disk



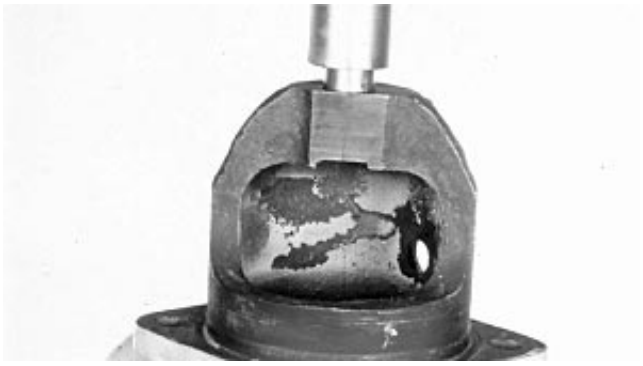
27493 Disk and 27491 Disk

RG,RG34710,2216 –19–15MAR97–3/3

60
10
20

Install Drive End Bushing and Wick

1. Install drive end bushing by pressing it from the outside in. Press it even with the end of the drive housing.



Drive End Bushing and Wick

RG,RG34710,2217 –19–15MAR97–1/2

2. Drill bushing through oil wick hole using same size drill as oil wick hole.
3. After drilling, ream bushing to maintain proper oil clearance between shaft and bushing.
4. Soak new wicks in SAE 10 engine oil. Install drive end wick and pipe plug.

Drive End Wick and Pipe Plug

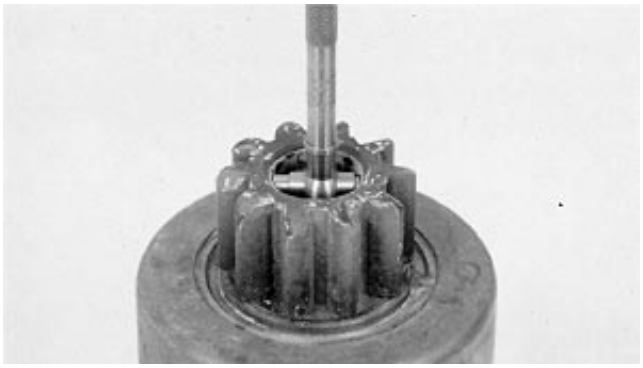
RG,RG34710,2217 –19–15MAR97–2/2

Inspect Drive Motor ID

Measure the motor drive ID.

Specification	
Motor Drive—ID	14.275—14.300 mm (0.5620—0.5630 in.)
Wear Limit	14.579 mm (0.5740 in.)

The motor drive cannot be repaired and must be replaced if defective.



Inspect Drive Motor ID

RG,RG34710,2218 –19–15MAR97–1/1

Inspect Center Bushing ID

Measure the center bushing ID and oil clearance.

Specification

New Center Bearing Plate	
Bushing—ID	19.304—19.354 mm (0.7600—0.7620 in.)
Wear Limit	19.608 mm (0.7720 in.)
Oil Clearance	0.254—0.381 mm (0.0100—0.0150 in.)
Wear Limit	0.635 mm (0.0250 in.)

Burnish bushing to size if necessary.

T81526 –UN–22MAR90

Inspect Center Bushing ID

RG,RG34710,2219 –19–15MAR97–1/1

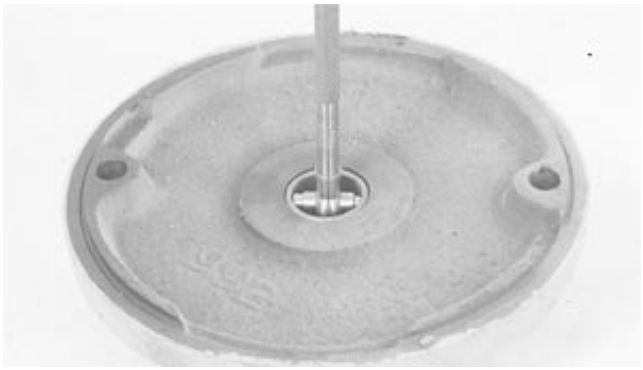
Inspect Commutator End Frame Bushing

Measure commutator end frame bushing ID and oil clearance.

Specification

New Commutator End Frame	
Bushing—ID	14.313—14.338 mm (0.5635—0.5645 in.)
Wear Limit	14.554 mm (0.5730 in.)
Oil Clearance	0.051—0.127 mm (0.0020—0.0050 in.)
Wear Limit	0.406 mm (0.0160 in.)

Burnish bushing to size if necessary.



T81527 –UN–22MAR90

Inspect Commutator End Frame Bushing

RG,RG34710,2220 –19–18OCT00–1/1

Assemble Starter Motor

1. Lubricate splines and drive end of armature shaft with SAE 10 engine oil.
2. Install center bearing plate and brake washer.

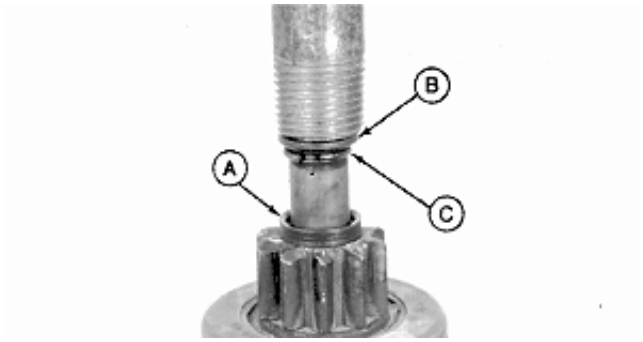
T81560 –UN–22MAR90

Lubricate Splines and Armature Shaft

RG,RG34710,2221 –19–15MAR97–1/7

3. With motor drive in place on armature shaft, install pinion stop (A) with cupped side toward drive end of armature shaft.
4. Use the drive end thrust collar (B) and a 1/2-in. pipe nipple, or other suitable metal cylinder, to drive the retaining ring (C) into its groove on the armature shaft.

A—Pinion Stop
B—Drive End Thrust Collar
C—Retaining Ring



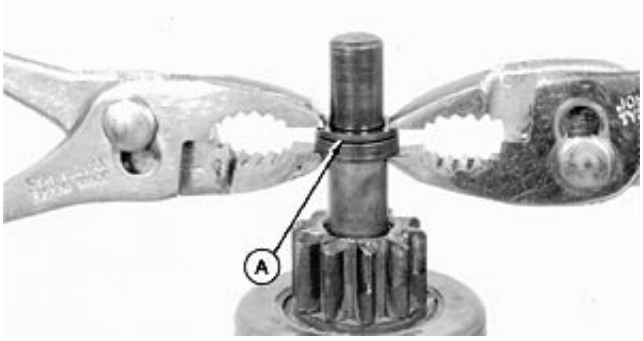
T88860 –UN–21FEB90

Armature Shaft

RG,RG34710,2221 –19–15MAR97–2/7

5. Use pliers and the drive end thrust collar (A) to force the pinion stop into place over the retaining ring.
6. Hold thrust collar (A) in place while installing armature.

A—Drive End Thrust Collar



T88861 –UN–21FEB90

Hold Thrust Collar

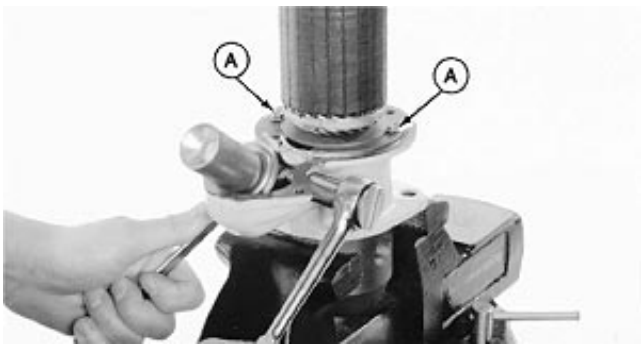
Continued on next page

RG,RG34710,2221 –19–15MAR97–3/7

7. With shift lever fork in motor drive collar, install armature, shift lever and solenoid switch plunger in drive housing.

8. Install the shift lever cap screw and the center bearing plate screws (A).

A—Center Bearing Plate Screws



T88855 –UN–21FEB90

Center Bearing Plate Screws

RG,RG34710,2221 –19–15MAR97–4/7

9. Install solenoid gasket and plunger return spring.

T81563 –UN–22MAR90

Solenoid Gasket/Plunger Return Spring

RG,RG34710,2221 –19–15MAR97–5/7

10. Install solenoid switch assembly and screws.

11. Install commutator end spacer washer (A).

A—Commutator End Spacer Washer

T88862 –UN–21FEB90

Commutator End Spacer Washer

Continued on next page

RG,RG34710,2221 –19–15MAR97–6/7

12. Install frame, with field coil assembly and brushes, onto rotor.

Specification

Housing Attaching Cap Screws—
Torque ..... 18—23 N•m (159—204 lb-in.)

13. Attach field connector to the solenoid switch “M” terminal.

14. Install commutator end frame and cap screws and tighten to specifications.

Specification

Commutator End Frame Cap
Screws—Torque ..... 18—23 N•m (159—204 lb-in.)

T81535 –UN–22MAR90

Install Commutator End Frame

RG,RG34710,2221 –19–15MAR97–7/7

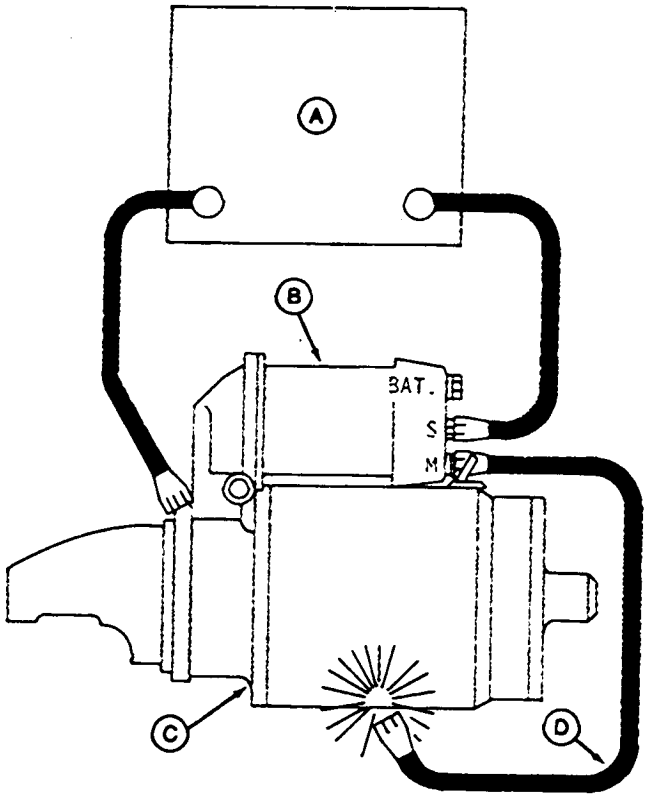
Check Pinion Clearance

Pinion clearance cannot be adjusted, but must be checked after reassembly of the starter motor. Improper clearance is an indication of worn parts.

1. Disconnect motor field coil connector from the solenoid motor terminal and insulate it carefully.

2. Make connections as shown using a 12-volt battery.

A—Battery
B—Solenoid
C—Starter Motor
D—Jumper Wire



T88952 –UN–25MAY89

Check Pinion Clearance

Continued on next page

RG,RG34710,2222 –19–15MAR97–1/2

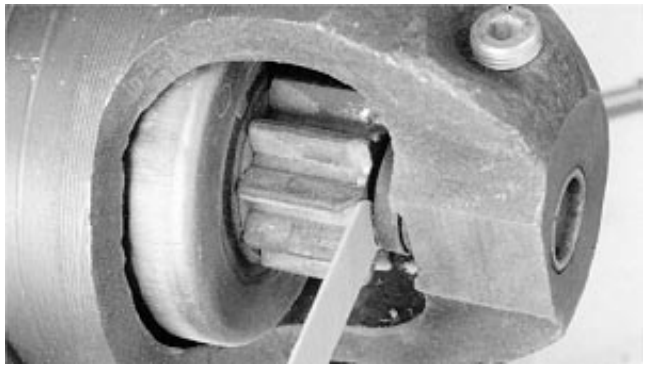
3. Momentarily touch a jumper lead from the solenoid motor terminal to solenoid frame. The pinion will shift into cranking position and remain until the battery is disconnected.

4. Push pinion toward armature.

5. Measure the distance between pinion and pinion stop.

Specification

Pinion-to-Pinion Stop—Clearance..... 0.25—3.56 mm (0.010—0.140 in.)



T81528 –UN–22MAR90

Push Pinion Toward Armature

RG,RG34710,2222 –19–15MAR97–2/2

60
10
25

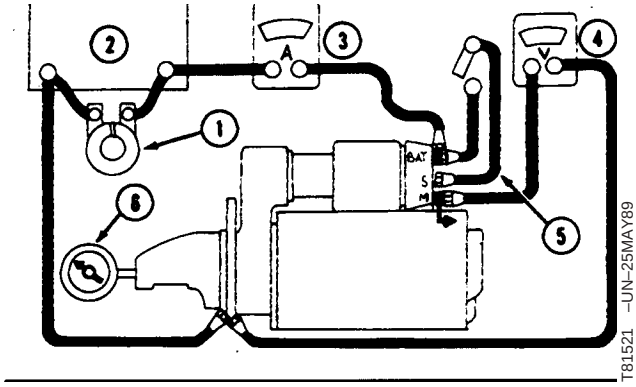
Make Solenoid No-Load Test

1. Clamp starter motor drive housing in vise.

2. Make connections as shown.

3. Close switch to operate starter motor and adjust carbon pile resistor to obtain 9.0 volts.

   Current draw must be to specifications given at beginning of this group.



T81521 –UN–25MAY89

Make Solenoid No-Load Test

1—Carbon Pile Resistor
2—Battery
3—Ammeter
4—Voltmeter
5—Jumper Lead with Switch
6—Tachometer

RG,RG34710,2223 –19–15MAR97–1/1

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B93 –19–08MAY02–1/3

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUO1004,0000B93 –19–08MAY02–2/3

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000B93 –19–08MAY02–3/3

Service Equipment and Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC). Some tools may be available from a local supplier.

60
15
2

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B94 –19–25SEP00–1/2

Bushing, Bearing, and Seal Driver Set. D01045AA

Remove and install all commutator, drive end, and center bushings and/or bearings.

OUO1004,0000B94 –19–25SEP00–2/2

Other Material

Number	Name	Use
	Mineral Spirits	Clean armature, solenoid and brushes.
	00 Sandpaper	Clean commutator.
	ESSO Beacon 325 or Delco-Remy No. 1960954 Lubricant	Lubricate various stator components.

OUO1004,0000B95 –19–25SEP00–1/1

Delco-Remy 30MT, 35MT, and 37MT Starter Motor Repair Specifications

Item	Measurement	Specification
Drive Housing Bushing	ID	14.28—14.33 mm (0.562—0.564 in.)
	Wear Tolerance	14.58 mm (0.574 in.)
	Oil Clearance	0.05—0.13 mm (0.002—0.005 in.)
	Wear Tolerance	0.43 mm (0.017 in.)
Lever Housing Bushing	ID	19.23—19.25 mm (0.757—0.758 in.)
	Wear Tolerance	19.61 mm (0.772 in.)
	Oil Clearance	0.25—0.33 mm (0.010—0.013 in.)
	Wear Tolerance	0.69 mm (0.027 in.)
Commutator End Frame Bushing	ID	14.28—14.33 mm (0.562—0.564 in.)
	Wear Tolerance	14.55 mm (0.573 in.)
	Oil Clearance	0.05—0.13 mm (0.002—0.005 in.)
	Wear Tolerance	0.41 mm (0.016 in.)
Brush	Minimum Length	12 mm (0.50 in.)
Brush	Minimum Tension	22 N (80 ounce-force)
Shift Lever Housing-to-Field Housing Cap Screws	Torque	18—23 N•m (159—204 lb-in.)
Drive Housing-to-Shift Lever Housing Cap Screws	Torque	18—23 N•m (159—204 lb-in.)
Commutator End-to-Field Frame Cap Screws	Torque	18—23 N•m (159—204 lb-in.)
Armature	End Play	0.13—1.27 mm (0.005—0.050 in.)
	Wear Limit	1.52 mm (0.060 in.)
Pinion-to-Pinion Stop	Clearance	0.25—3.56 mm (0.010—0.140 in.)

OUO1004,0000B96 –19–25SEP00–1/1

Delco-Remy 30MT, 35MT, and 37MT Starter Motor Test Specifications

NOTE: Specification data for starters marked with an asterisk (*) was not available from Delco. Data provided for these asterisked starters in the following table was obtained from the John Deere Alternator, Generator, Starter and Battery Bench Tester Operator's Manual (OMTY25323, 14Dec01). This data is for remanufactured starters, provided by suppliers other than Delco, which can be used as replacements for the Delco starters. Specifications for the remanufactured starters may not correspond exactly with the original Delco starter specifications, and should be used for reference only. Delco does not either approve nor disapprove the use of these specifications.

60
15
4

				No Load Test (Includes Solenoid Current)	
John Deere Starter Motor Part No.	**Delco-Remy Starter Motor Model No. -Series**	**System Voltage**	**Motor Voltage**	**Current Draw (Amps)**	**Armature RPM**
* AB2937R	1107445	6	5 Min	70 Max	6000
* AB4093R	1107445	6	5 Min	70 Max	6000
AB4094R	1107193	6	5	30—60	2900—5300
* AB4649R	1108144	12	10	90 Max	3500—6000
* AB4860R	1108155	12	10	90 Max	3500—6000
* AF1392R	1108990-30MT	12	10	60 Max	3500—5500
* AF1578R	110981	12	10	60 Max	3500—5500
AF2673R	1113304	12	—	—	—
AF3758R	1113079	12	—	—	—
* AM1802T	1107127	6	5 Min	140 Max	4500—6400
AM3397T	1107165	6	5.6	70	5500
AR11010	1107725	12	9	50—75	4500—6400
* AR11011	1113092-30MT	12	10	80 Max	7000 Min
AR11138	1107555	24	20	52—90	7000—13000
AR11141	1113135	24	20	50—70	7000—9500
* AR11151	1107193	6	5	65 Max	2900—5300
AR11152	1108180	12	9	50—75	3500—6000
* AR11159	1113005	12	10	60 Max	3500—5500
AR11300	1107785	12	9	55—80	3500—6000
AR28053	1113148	24	20	50—70	7000—9500
AR34406	1113656-35MT	12	9	75—105	5000—7000

Continued on next page

				No Load Test (Includes Solenoid Current)	
John Deere Starter Motor Part No.	**Delco-Remy Starter Motor Model No. -Series**	**System Voltage**	**Motor Voltage**	**Current Draw (Amps)**	**Armature RPM**
* AR40134	1113190-30MT	24	20	80 Max	7000 Min
AR41627	1113402-35MT	12	9	124—185	4700—7600
AR55638	1113672-35MT	12	9	124—185	4700—7600
AR62267	1113402-35MT	12	9	124—185	4700—7600
AR72308	1113093-35MT	12	9	50—70	3500—5500
AR77254	1113391-35MT	12	9	124—185	4700—7600
AR78538	1113391-35MT	12	9	124—185	4700—7600
AR91813	1109576-SD300	12	10	65—110	6500—10700
AT10224	1108072	6	5.7	53—91	3650—6350
AT15334	1107523	12	9	50—80	5500—9000
AT16209	1107556	12	9	40—140	8000—13000
AT16880	1108099	6	5	90—125	2900—5300
AT16881	1107200	6	5.7	90—125	4500—6400
AT91813	1109421-SD300	12	10	60—90	6500—10500
RE27462	1993799-37MT	12	10	140—175	6600—8200
RE29400	1993829-37MT	24	20	115—175	3000—4800
RE36646	1993930-37MT	24	20	50—75	3300—4400
RE37961	1993894-37MT	12	10	120—160	6000—8700
RE38632	1993917-37MT	24	20	50—75	3300—4400
RE41755	1993894-37MT	12	10	120—160	6000—8700
RE43300	1993917-37MT	24	20	50—75	3300—4400
RE48077	10478819-37MT	24	20	50—75	3300—4400
RE48134	1993917-37MT	24	20	50—75	3300—4400
RE52955	10478957-37MT	12	10	120—160	6000—8700
RE53217	10478957-37MT	12	11	130—175	6100—8700
RE53404	10478814-37MT	24	20	50—75	3300—4400
RE53575	10478814-37MT	24	20	—	3300—4400
RE59586	10478819-37MT, 10479180	24	20	50—75	3300—4400
RE59593	10478957-37MT	12	11	130—175	6100—8700
RE59594	10478814-37MT, 10479181	24	20	50—75	3300—4400
RE65189	10478814-37MT	24	20	50—75	3300—4400

RG,RG34710,2227 –19–07JUL05–2/2

Diagnosing Starter Motor Malfunctions

Fails to Operate, No Current Draw

Open field circuit (all field windings)

Open armature windings

Defective brush contact with commutator

Open solenoid windings

Defective solenoid contacts

Fails to Operate, High Current Draw

Grounded field windings or armature windings

Seized bearings

Low Speed, Low Current Draw

High internal resistance

Defective brush contact with commutator

Low Speed, High Current Draw

Excessive friction

Shorted armature

Grounded armature or field windings

High Speed, High Current Draw

Shorted field windings

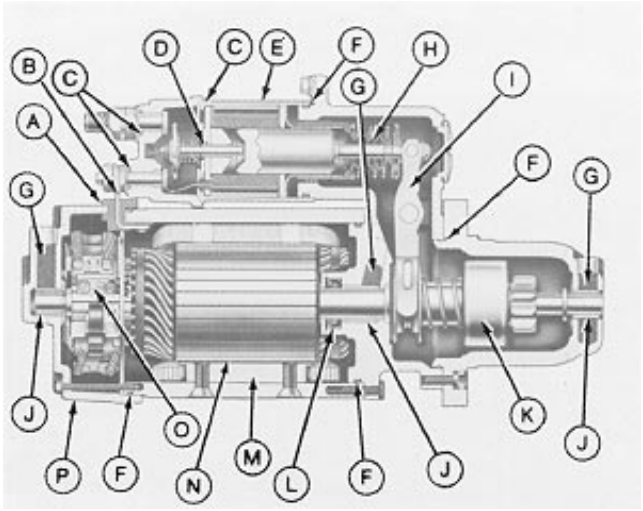
NOTE: This test will not detect individual open-circuited field coils—the stator would have a slow cranking speed but would pass this test.

RG,RG34710,2228 –19–15MAR97–1/1

Delco-Remy Starter Motor Cutaway View—Series 30MT, 35MT, and 37MT

IMPORTANT: Never operate starter motor more than 30 seconds. Allow at least 2 minutes for cooling and battery recovery before operating again. Overheating, caused by excessive operation, will seriously damage starter motor.

NOTE: Series 37MT starter motors use TORX® screws for all external fasteners. Two different size TORX® drivers are required to service the 37MT motor—T40 and E8. These drives can be procured from a local tool source.



RG4993 –UN–19JAN90

Series 37MT Shown

A—Grommet
B—Field Connectors
C—Gaskets
D—Plunger
E—Solenoid
F—O-Ring
G—Oil Wick
H—Boot
I—Shift Lever
J—Bushing
K—Overrunning Clutch
L—Seal
M—Field Coil
N—Armature
O—Brushes
P—End Cap

TORX is a registered trademark of Camcar/Textron.

RG,RG34710,2229 –19–15MAR97–1/1

Test Starter Motor Before Disassembly

1. Turn overrunning clutch pinion by hand. Clutch pinion should turn freely on shaft in overrunning direction only.

Turn Overrunning Clutch Pinion

RG,RG34710,2230 –19–15MAR97–1/4

2. Turn armature by prying against pinion with screwdriver. Check for dragging armature, seized bushings or bent shaft.

   If you discover any interference, disassemble and repair starter motor. Do not conduct no-load test unless armature turns freely.

Turn Armature

Continued on next page

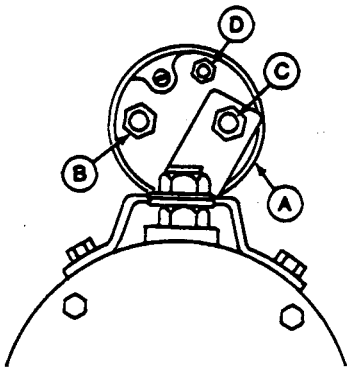
RG,RG34710,2230 –19–15MAR97–2/4

3. Connect a 12-volt battery to solenoid (A) with heavy-duty jumper cables. Connect battery terminal (B) on solenoid to positive battery terminal and motor terminal (C) to negative battery terminal.

IMPORTANT: Do not engage solenoid longer than one to two seconds, because closing solenoid switch provides a dead short across battery.

4. Use a screwdriver blade to short across from battery terminal to switch terminal (D). Solenoid should engage, pushing overrunning clutch drive to engage position.

   When screwdriver is removed, solenoid should return sharply to the disengage position. If solenoid engages but then chatters instead of staying firmly engaged, hold-in winding is defective and solenoid must be replaced. Be sure solenoid is connected securely to start frame. If shift lever or overrunning clutch drive appears to bind, disassemble and repair starter.



RG4666 –UN–06APR89

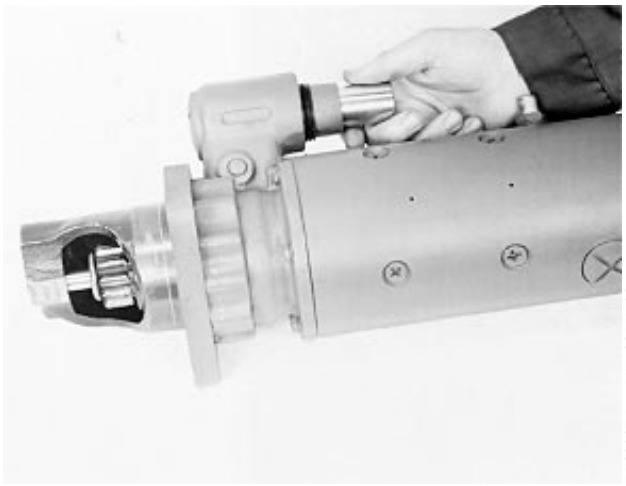
Terminals

A—Solenoid
B—Battery Terminal
C—Motor Terminal
D—Switch Terminal

60
15
9

RG,RG34710,2230 –19–15MAR97–3/4

5. If solenoid does not engage, remove solenoid and manually move shift lever back and forth. If lever moves smoothly, pull-in winding is defective and solenoid must be replaced. If there is pressure felt when moving the shift lever, but solenoid does not engage when tested, disassemble and repair starter.



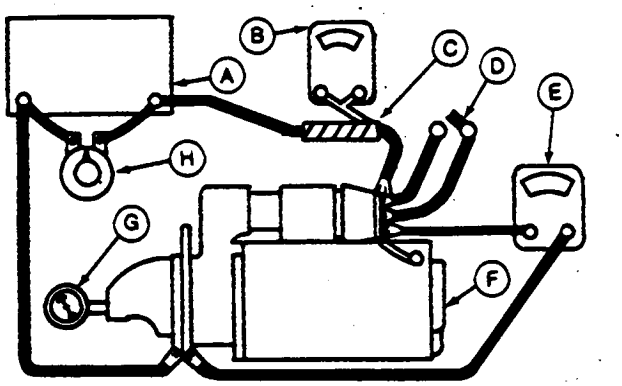
R78220P1 –UN–23JAN90

Check for Defects

RG,RG34710,2230 –19–15MAR97–4/4

Make No-Load Test for Solenoid

1. If armature turns freely, make connections as shown. Use an ammeter capable of measuring several hundred amps. Make sure the battery is fully charged.
2. Close switch to operate starter motor and adjust carbon pile resistor to obtain specified voltage. Compare rpm and current draw with values given in specifications at the beginning of this group.
3. If speed and current draw are slightly low, connect a voltmeter between motor terminal and field frame. Voltage during test may be reduced because of high current draw on battery.
4. If speed or current draw is significantly different than specified, use the diagnostic list earlier in this group.

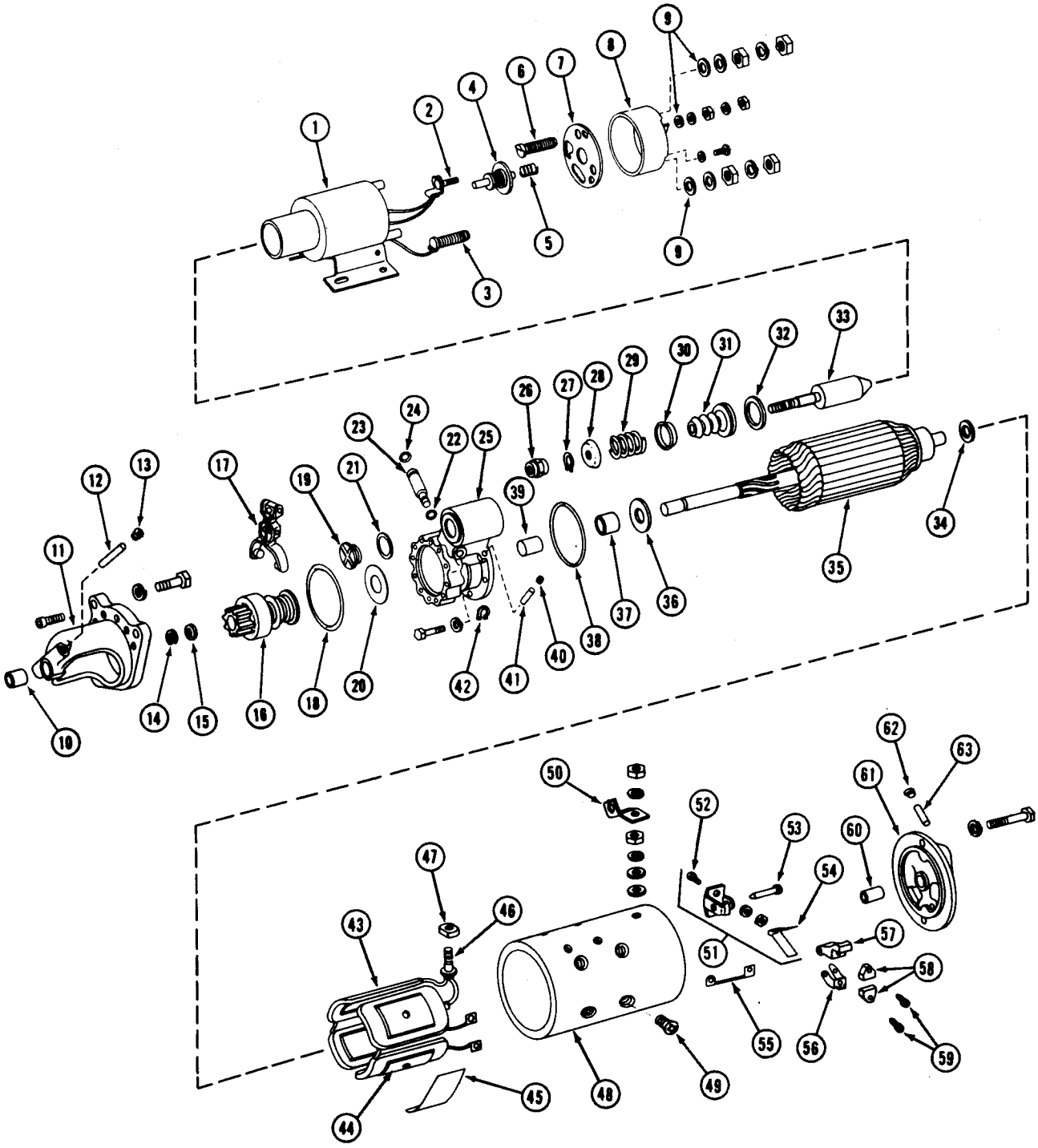


Make No-Load Test for Solenoid

A—Battery
B—Ammeter
C—Shunt
D—Switch
E—Voltmeter
F—Starter Motor
G—Tachometer
H—Carbon Pile Resistor

RG,RG34710,2231 –19–15MAR97–1/1

Disassemble Delco-Remy Starter Motor (Series 35MT Illustrated)



Series 35MT

Continued on next page

RG,RG34710,2232 –19–12SEP02–1/8

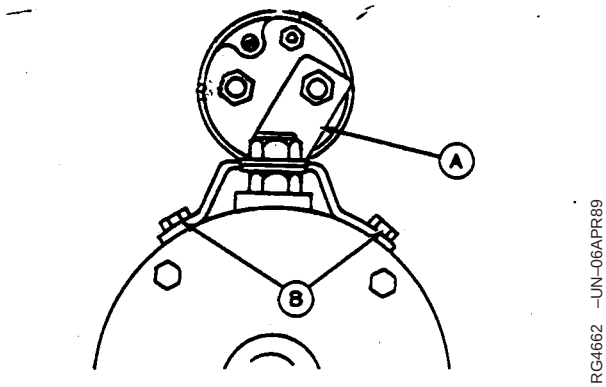
1—Solenoid Case and Coil
2—Switch Terminal Stud (2 Used)
3—Motor Terminal Stud
4—Contact Disk and Push Rod
5—Return
6—Battery Terminal Stud
7—Cover Gasket
8—Cover
9—Sealing Washer
10—Rear Bushing
11—Drive Housing
12—Wick
13—Pipe Plug
14—Retaining Ring
15—Pinion Stop
16—Overrunning Clutch Drive
17—Shift Lever
18—O-Ring
19—Plug
20—Brake Washer
21—Gasket
22—O-Ring
23—Shift Lever Shaft
24—O-Ring
25—Shift Lever Housing
26—Special Nut
27—Retaining Ring
28—Spring Retainer
29—Shift Lever Spring
30—Spring Retainer
31—Boot
32—Washer
33—Plunger
34—Washer
35—Armature
36—Spacer
37—Oil Seal
38—O-Ring
39—Center Bushing
40—Pipe Plug
41—Wick
42—Retaining Ring
43—Field Winding Assembly
44—Pole Shoe (4 Used)
45—Insulator (2 Used)
46—Field Terminal Stud
47—Insulator Bushing
48—Main Frame
49—Machine Screw (8 Used)
50—Field Winding Connector
51—Brush Support (2 Used)
52—Brush Holder Support Pin (2 Used)
53—Brush Holder Pin (2 Used)
54—Brush Spring (2 Used)
55—Brush Spring Lead (2 Used)
56—Brush Holder (2 Used)
57—Brush Holder (2 Used)
58—Brush (4 Used)
59—Tapping Screw (4 Used)
60—Front Bushing
61—Commutator End Frame
62—Pipe Plug
63—Wick

60
15
13

RG,RG34710,2232 –19–12SEP02–2/8

1. Clean exterior of starter motor with compressed air before disassembling.
2. Remove field winding connector (A).
3. Remove solenoid mounting cap screws (B).
4. Remove nuts and sealing washers (9) from solenoid motor and “S” terminals. (See exploded view.)
5. Remove switch cover (8) and cover gasket (7).

A—Field Winding Connector
B—Solenoid Mounting Cap Screws



RG4662 –UN–06APR89

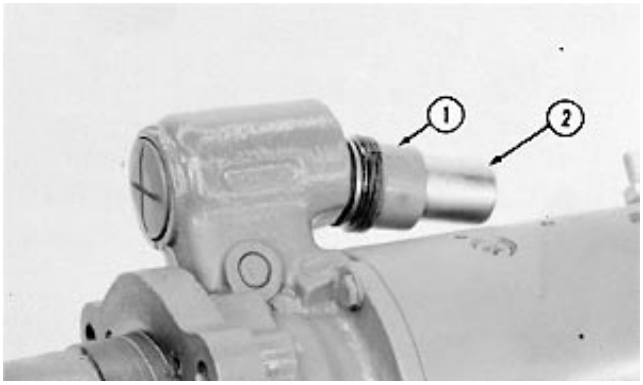
Field Winding Connector and Cap Screws

Continued on next page

RG,RG34710,2232 –19–12SEP02–3/8

6. Push boot (1) back, and slide solenoid away (shown removed) from boot and plunger (2).

1—Boot
2—Plunger



RG2989 –UN–17JUL89

Solenoid Removed

RG,RG34710,2232 –19–12SEP02–4/8

7. IF NECESSARY, remove cover plug and disconnect solenoid plunger from shift lever. Grasp plunger and remove self-locking nut.

NOTE: Pinion clearance is controlled by self-locking nut. Do not change adjustment unless complete disassembly is required. Check pinion clearance, covered later in this group.

8. Scribe a mark across main frame (48) and end frame (61) as reassembly reference. (See exploded view.)

9. Remove four cap screws attaching commutator end frame to main frame.

10. Remove commutator end frame.

R78220T1 –UN–23JAN90

Remove Commutator End Frame

Continued on next page

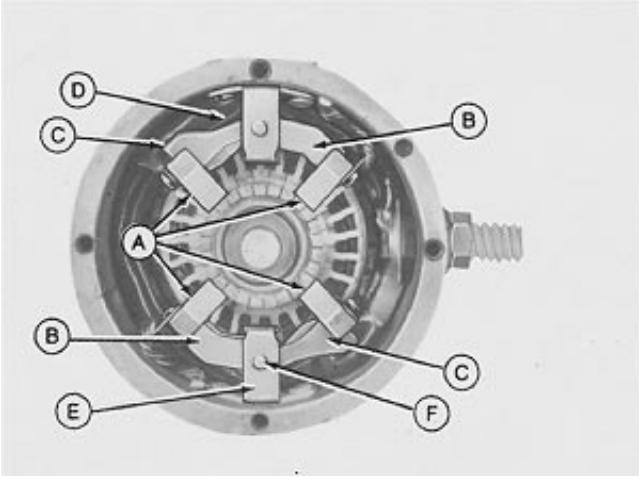
RG,RG34710,2232 –19–12SEP02–5/8

11. Slide brush holder pin (F) out of support (E) to remove brushes (A). Remove tapping screws (D) which attach brushes to grounded brush holders (B) and insulated brush holders (C).

12. Scribe a mark across drive housing and shift lever housing for proper assembly.

13. Remove drive end housing cap screws and remove drive housing.

A—Brushes
B—Grounded Brush Holders
C—Insulated Brush Holders
D—Tapping Screws
E—Support
F—Pin



RG4663 –UN–19JAN90

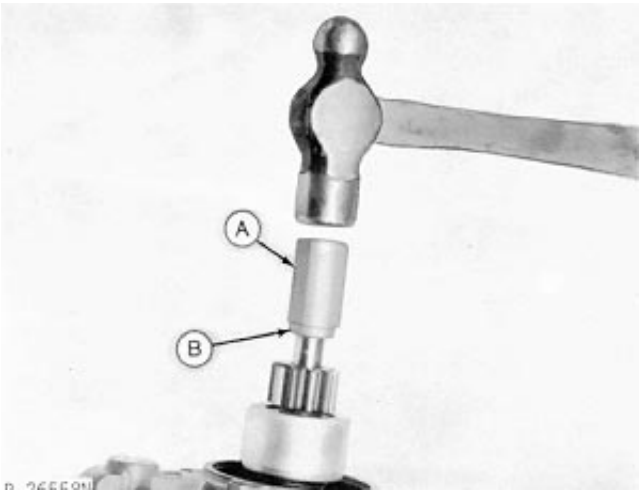
Remove Drive Housing

RG,RG34710,2232 –19–12SEP02–6/8

14. Remove pinion stop (B). Use a pipe coupling (A) or other metal cylinder to drive pinion stop toward pinion as shown. Remove retaining ring and slide pinion stop off shaft.

15. Slide shift lever housing and overrunning clutch drive off shaft.

A—Pipe Coupling
B—Pinion Stop



R26558 –UN–09FEB90

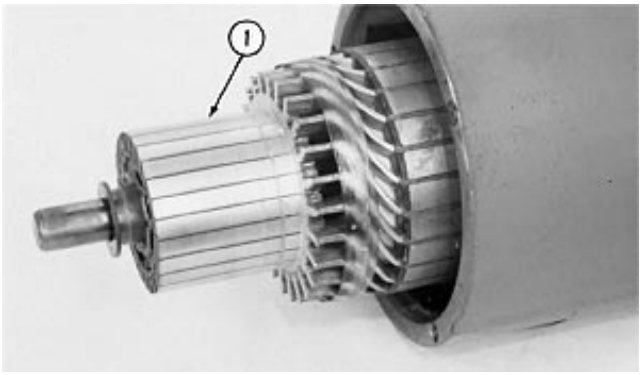
Pinion Stop and Pipe Coupling

Continued on next page

RG,RG34710,2232 –19–12SEP02–7/8

16. Carefully slide armature (1) out of field frame. If spacer washer remains in housing, pull it out and install on shaft.

1—Armature



Slide Armature

RG,RG34710,2232 –19–12SEP02–8/8

Install New Bushings During Disassembly

NOTE: Refer to exploded view earlier in this group.

1. Remove plugs (13 and 62) and lubricating wicks (12 and 63).

2. Replace bushings (10, 39, and 60) if worn longer than wear tolerances given.

Specification

Drive Housing Bushing—ID..... 14.28—14.33 mm (0.562—0.564 in.)
Wear Tolerance..... 14.58 mm (0.574 in.)
Oil Clearance..... 0.05—0.13 mm (0.002—0.005 in.)
Wear Tolerance..... 0.43 mm (0.017 in.)

Specification

Lever Housing Bushing—ID..... 19.23—19.25 mm (0.757—0.758 in.)
Wear Tolerance..... 19.61 mm (0.772 in.)
Oil Clearance..... 0.25—0.33 mm (0.010—0.013 in.)
Wear Tolerance..... 0.69 mm (0.027 in.)

Specification

Commutator End Frame
Bushing—ID..... 14.28—14.33 mm (0.562—0.564 in.)
Wear Tolerance..... 14.55 mm (0.573 in.)
Oil Clearance..... 0.05—0.13 mm (0.002—0.005 in.)
Wear Tolerance..... 0.41 mm (0.016 in.)

3. Remove the commutator end frame housing (61) using a blind hole puller. Remove other bushings using drivers from tool set listed below.

   Use the following disks from D01045AA Bushing, Bearing and Seal Driver Set when replacing bushing.

Bushing	Pilot Disk	Drive Disk
Drive Housing Bushing	27491	27495
Commutator Bushing	27491	27494
Lever Housing Bushing	27494	27497

4. Drive new bushings into end frame to same depth as old bushing.

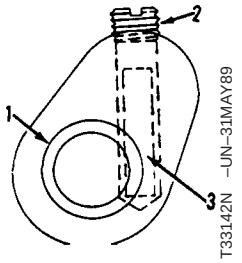
Continued on next page

5. Use a drill the same size as the oil wick hole and drill bushing (1).

   Only if necessary, carefully ream bushing to size.

6. Saturate new wicks (3) with SAE 10W clean engine oil and install.

7. Install plug (2) and tighten securely.



Install Plug

60
15
18

1—Drill Bushing
2—Plug
3—Oil Wick

RG,RG34710,2233 –19–15MAR97–2/2

Clean Starter Motor Components

IMPORTANT: Never clean armature, field windings, or overrunning clutch drive in solvent. All parts except overrunning clutch drive may be cleaned with mineral spirits and a brush.

1. Clean components using mineral spirits and a brush.

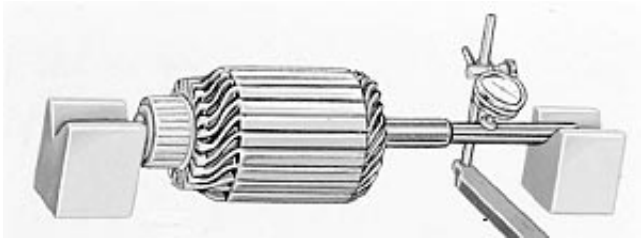
2. Dry with compressed air or a clean cloth.

RG,RG34710,2234 –19–15MAR97–1/1

Inspect Armature

1. Place armature in V-blocks and check for a bent shaft. Replace armature if shaft is bent.
2. Inspect armature for signs of dragging against pole shoes or scoring under bushings.
3. Carefully check commutator for roughness, burned commutator bars or any material that might cause short circuits between bars.
4. Clean and touch up commutator, if necessary, with 00 sandpaper. NEVER use emery cloth.

NOTE: If commutator is out of round, badly burned or rough, it can be turned down slightly on a lathe. Remove only enough metal to eliminate problem. Do not undercut commutator after turning, as this will cause shorts between commutator bars.



X1451 –UN–25JAN89

Inspect Armature

60
15
19

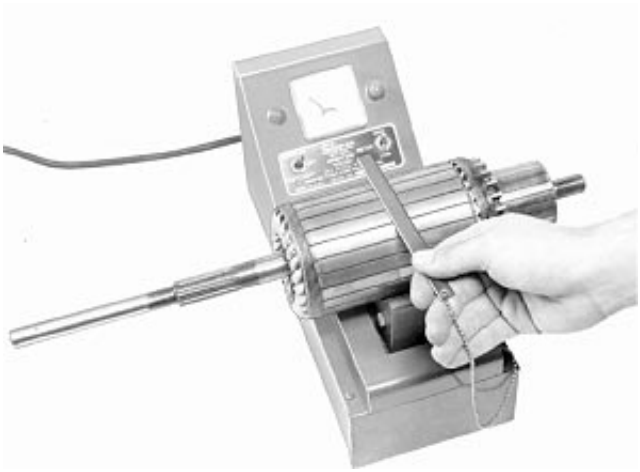
RG,RG34710,2235 –19–15MAR97–1/1

Make Short Circuit Test

Place armature in a growler and hold hacksaw blade above each slot while slowly rotating the armature.

If coil is shorted, the blade will be attracted to and repelled from the slot.

Short circuit most often occurs because of copper dust or filings between segments. Clean commutator segments to correct this short.



RG78074C1 –UN–09JAN90

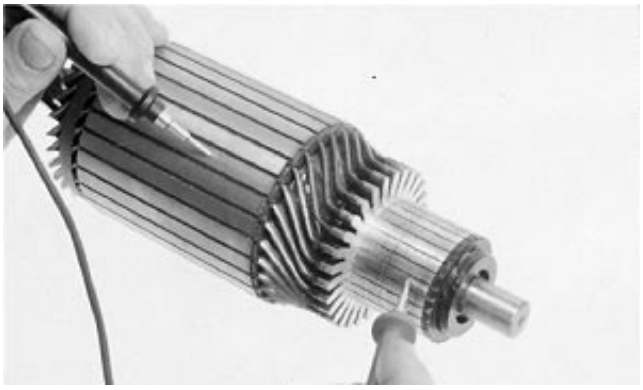
Make Short Circuit Test

RG,RG34710,2236 –19–15MAR97–1/1

Make Armature Ground Test

1. Set ohmmeter to read on highest scale.
2. Place one test lead on the armature core or shaft. Place other lead on commutator.

   If the test meter indicator swings toward zero, the armature is grounded. Replace armature.



Make Armature Ground Test

RG,RG34710,2237 –19–15MAR97–1/1

Make Open Circuit Test

1. Set ohmmeter to read on lowest scale.
2. Place one test lead on ohmmeter segment. Place other test lead on an adjacent segment.
3. Repeat this operation for all segments by moving one lead at a time.

   If the test meter indicator does not swing to zero and remains stationary, the armature coil between these two segments is open. Replace armature.

Make Open Circuit Test

RG,RG34710,2238 –19–15MAR97–1/1

Make Ground Circuit Test for Field Windings

1. Set the D09001TT Volt-Ohm-Amp Meter to read on highest scale.
2. Place one test lead on a clean spot on field frame. Place other lead on the copper terminal bolt.

   If the ohmmeter indicator swings toward zero, a grounded circuit is indicated. Replace the field windings.

RG780760Q1 –UN–09JAN90

Make Ground Circuit Test

60
15
21

RG,RG34710,2239 –19–06MAY02–1/1

Make Open Circuit Test for Shunt Windings

1. Set ohmmeter on its lowest scale.
2. Place one test lead on the eyelet terminal. Place other lead on the terminal bolt.

   If the ohmmeter does not swing to zero, it is open circuited. Replace the field winding assembly.

RG,RG34710,2240 –19–15MAR97–1/1

Make Open Circuit Test for Field Windings

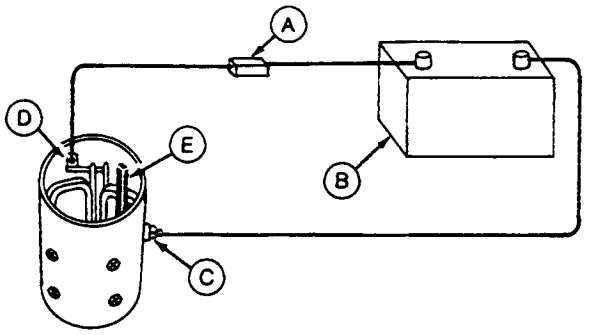
All four windings are connected in parallel. Test each winding for an open circuit.

1. Connect a test battery (B) to field terminal (C) and either insulated brush lead (D) using a resistor (A) to limit current draw.

2. Use a hacksaw blade (E) to test windings for magnetism. If any winding is not magnetic, the winding is open circuited. Repair or replace windings.

NOTE: Because 1/4 ohm resistors capable of carrying several hundred watts are not widely available, a suggested alternative is to connect four 1-ohm resistors in parallel. Each resistor should be rated for at least 150 watts. A carbon pile resistor can also be used. Limit current to 40—70 amps.

There is no suitable way to check field windings for short circuits. Winding resistance is too low to permit detection of a short circuit.



R265544N –UN–11APR89

Make Open Circuit Test

A—1/4-Ohm Resistor
B—12-Volt Battery
C—Field Terminal
D—Insulated Brush Lead
E—Hacksaw Blade

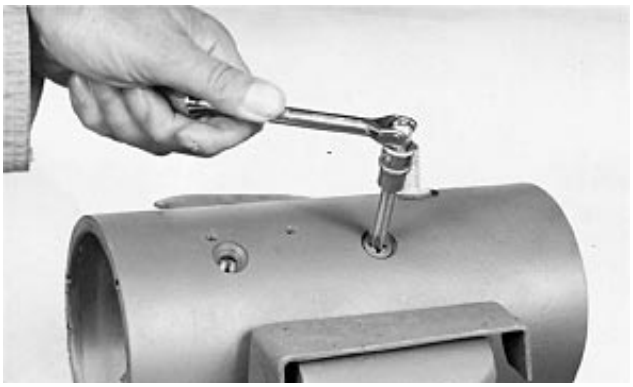
RG,RG34710,2241 –19–09OCT00–1/1

Remove Field Windings

1. If field windings are suspected of being damaged, place field frame in a soft-jawed vise.

NOTE: Do not squeeze sides of field frame in vise or strike with a hammer. If an impact screwdriver is used to remove pole shoe screws, support each pole shoe individually using a pole shoe spreader or the nose of an anvil.

2. Use a large screwdriver or bit and socket wrench on pole shoe screws.



R782211I –UN–23JAN90

Remove Field Windings

Continued on next page

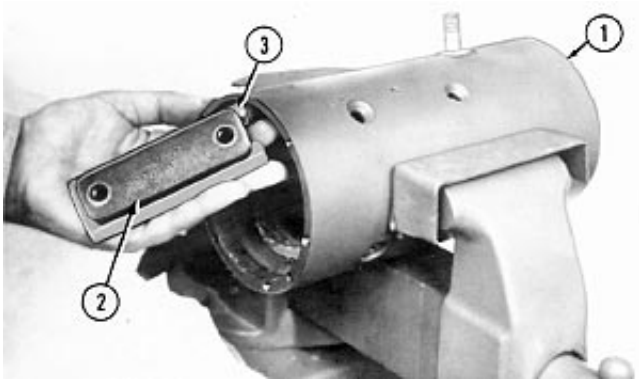
RG,RG34710,2242 –19–15MAR97–1/2

3. Remove pole shoes (2). Then carefully remove field windings as an assembly.

IMPORTANT: Handle windings very carefully. Windings are easily damaged, causing shorts, opens, or grounds.

4. Install new field windings and tighten pole shoe screws as tight as possible. Use a center punch to lightly stake one edge of each screw.

IMPORTANT: Make sure the notched end (3) on pole shoe is facing the brush end of the field frame starter (1).



RG2995 –UN–17JUL89

New Field Windings

1—Starter Field Frame
2—Pole Shoe
3—Notched End

RG,RG34710,2242 –19–15MAR97–2/2

60
15
23

Inspect Brushes

1. Inspect brushes (58) closely. (See exploded view this group.) Make sure brush holders (56 and 57) are clean and are not binding. Full width of brush should contact commutator.

2. Replace brushes if they are oil soaked or are worn beyond specifications.

	Specification
Brush—Minimum Length	12 mm (0.50 in.)

RG,RG34710,2243 –19–09OCT00–1/1

Test Brush Holder for Ground

1. Set ohmmeter on its highest scale.

2. Place one test lead on commutator end frame. Place other lead on brush holder.

   If dial indicator swings toward zero, the positive brush holder is grounded and should be replaced.

RG,RG34710,2244 –19–15MAR97–1/1

Inspect Brush Springs

1. Inspect and replace brush springs if they are distorted or discolored.

2. Measure brush spring tension with a spring scale.

Specification	
Brush—Minimum Tension	22 N (80 ounce-force)

60
15
24

RG,RG34710,2245 –19–15MAR97–1/1

Inspect and Clean Solenoid

1. Replace contact disk (4, see exploded view in this group), if it is badly corroded.

2. Be sure all connections are clean and tight. Wipe parts with mineral spirits and brush. Dry clean with a cloth.

IMPORTANT: Solenoid contacts and plunger will be damaged if current is applied to solenoid when removed from starter motor.

RG,RG34710,2246 –19–15MAR97–1/1

Assemble Solenoid

NOTE: Replacement "S" terminal clips and motor terminal studs are soldered to wiring leads.

1. Assemble solenoid parts using a new gasket (7, see exploded view in this group) and sealing washers (9).

2. Tighten cover (8) screws securely.

RG,RG34710,2247 –19–15MAR97–1/1

Inspect Plunger, Shift Lever, and Overrunning Clutch Assembly

1. Remove plug (19, see exploded view in this group) and inspect shift lever spring (33) and shift lever assembly for wear or damage.
2. Press plunger inward and check tension on plunger spring (29). Spring should not compress easily. Replace plunger assembly if spring is weak.
3. Inspect overrunning clutch drive (16) for wear or damage. Rotate the pinion. Pinion gear should rotate smoothly (but not easily) in one direction. The pinion gear should not rotate in the opposite direction.
4. If pinion gear does not rotate smoothly or if it is worn, chipped, or burred, replace clutch drive assembly.

IMPORTANT: Do not clean overrunning clutch drive with solvent. Solvent would dissolve lubricant in clutch mechanism. Clean only by wiping with a clean cloth. Do not lubricate drive.

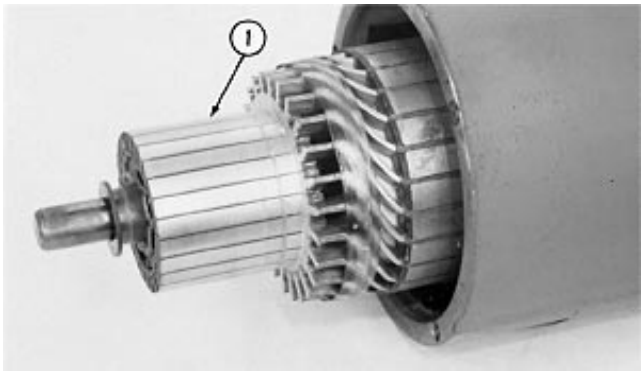
RG,RG34710,2248 –19–09OCT00–1/1

Assemble Starter Motor

1. Carefully install armature (1) into field frame. Be sure spacer is installed on end of armature shaft before installing into main frame.

IMPORTANT: To avoid possible damage to brush holders, it is best to install brush assembly dismantled.

1—Armature



RG2992 –UN–17JUL89

Install Armature

Continued on next page

RG,RG34710,2249 –19–12SEP02–1/4

NOTE: Always use new O-rings, packing, and gaskets when assembling starter motor.

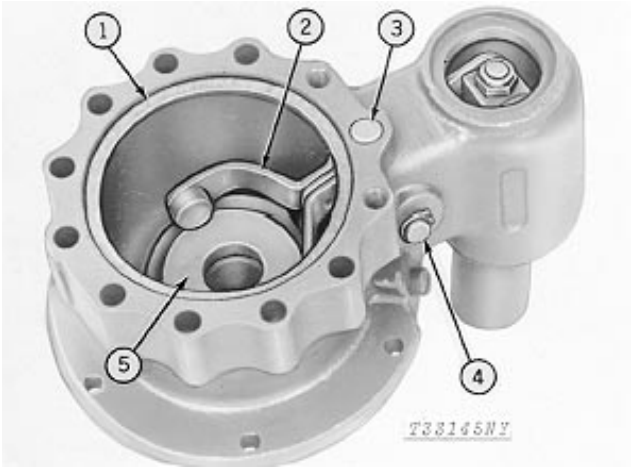
2. Lubricate bearing surface with Delco-Remy No. 1960954 Lubricant or its equivalent.

3. Install seal plug (3), gasket (1) and brake washer (5) into shift lever housing.

60
15
26

4. Place overrunning clutch drive in shift lever housing, making certain that shift lever is engaged in slot.

5. Slide shift lever housing and overrunning clutch drive into armature shaft.



T33145NY –UN–27JUL89

Shift Lever Housing

1—Gasket
2—Shift Lever
3—Seal Plug
4—Shift Lever Shaft
5—Brake Washer

Continued on next page

RG,RG34710,2249 –19–12SEP02–2/4

6. Slide pinion stop (A) onto shaft, with open side toward end of shaft. Install retaining ring (B) in groove. Force pinion stop over ring, using a washer (C) and two pairs of pliers as shown. Remove washer.

NOTE: Series 37MT starter motors have TORX® screws for all external fasteners. Tighten screws to same torque values as given for conventional screws.

7. Install shift lever housing on field using five cap screws and lock washers. Tighten screws to specifications.

Specification

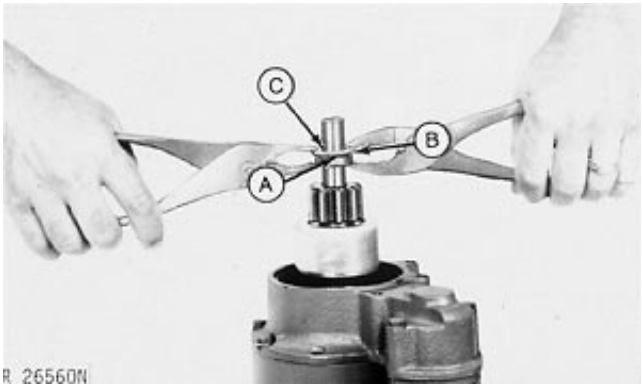
Shift Lever Housing-to-Field
Housing Cap Screws—Torque..... 18—23 N•m (159—204 lb-in.)

8. Align scribe marks on drive housing and shift lever housing (made during disassembly). Install the six special screws in drive housing. Tighten screws to specifications.

Specification

Drive Housing-to-Shift Lever
Housing Cap Screws—Torque..... 18—23 N•m (159—204 lb-in.)

9. If pinion clearance has not been changed, install hole plug (19, see exploded view in this group) in shift lever housing. Otherwise, it should be left out until clearance is adjusted at conclusion of assembly.



Pinion Stop

A—Pinion Stop
B—Retaining Ring
C—Washer

60
15
27

TORX is a registered trademark of Camcar/Textron.

Continued on next page

RG,RG34710,2249 –19–12SEP02–3/4

10. Install brush holders (B and C), brushes (A) and springs (D). When installing brushes, turn longer side toward armature windings. Make sure full width of each brush contacts commutator and brush holders are not binding.

11. Install commutator end frame on field frame (position so scribe marks made during disassembly are aligned). Tighten cap screws securely and evenly to specifications.

60
15
28

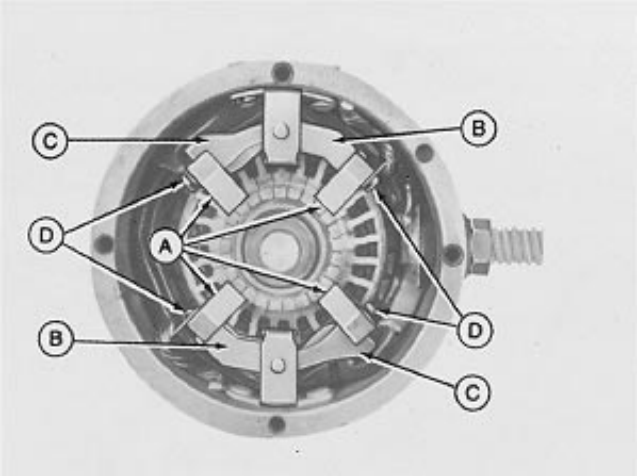
Specification

Commutator End-to-Field Frame
Cap Screws—Torque ..... 18—23 N•m (159—204 lb-in.)

12. Install solenoid on field frame. Be sure that plunger (33, see exploded view) and boot (31) are installed correctly. Tighten solenoid-to-field frame cap screws securely.

NOTE: Do not install field winding connector (50) until pinion clearance has been checked.

13. Check armature end play and pinion clearance before installing starter motor.



RG4664 –UN–19JAN90

Brushes, Holders, and Springs

A—Brushes
B—Grounded Brush Holders
C—Installed Brush Holders
D—Brush Springs

RG,RG34710,2249 –19–12SEP02–4/4

Check Armature End Play

1. Attach a dial indicator on drive housing and position indicator plunger on end of armature shaft to measure end play.

Specification

Armature—End Play..... 0.13—1.27 mm (0.005—0.050 in.)
Wear Limit ..... 1.52 mm (0.060 in.)

2. If end play is not within specifications, recheck installation to determine cause.

RG,RG34710,2250 –19–15MAR97–1/1

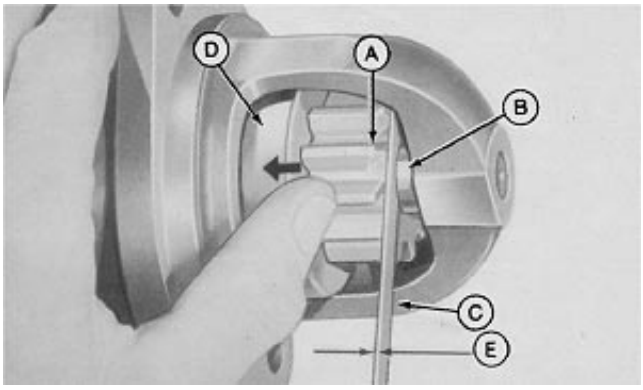
Check for Proper Pinion Clearance

1. Connect a 12-volt battery to the solenoid frame and “S” terminal.
2. Momentarily connect a jumper wire between solenoid frame and motor terminal to pull solenoid plunger in.
3. Press overrunning clutch (D) toward commutator and measure pinion clearance (E) with a feeler gauge (C).
4. Clearance between pinion (A) and pinion stop (B) should be as follows:

Specification

Pinion-to-Pinion Stop—Clearance..... 0.25—3.56 mm (0.010—0.140 in.)

5. If pinion clearance is not within specifications, turn self-locking nut (26, see exploded view in this group) to adjust clearance.
6. After adjusting to correct pinion clearance, install adjusting hole plug (19) and tighten securely.
7. Install field winding connector (50). Tighten nuts securely.



R25224 –UN–09FEB90

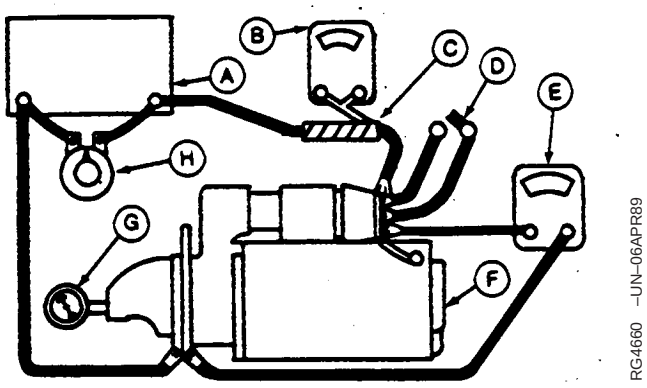
Check for Proper Pinion Clearance

A—Pinion
B—Pinion Stop
C—Feeler Gauge
D—Press on Clutch to Take Up Movement
E—0.25—3.56 mm (0.010—0.140 in.) Clearance

RG,RG34710,2251 –19–12SEP02–1/1

Make No-Load Test (After Assembly)

1. Clamp starter in vise.
2. Connect a fully charged 12-volt battery (A), ammeter (B), shunt (C), control switch (D), voltmeter (E) carbon pile resistor (H), and tachometer (G) to starter motor (F).
3. Close switch to operate starter motor and adjust carbon pile resistor to obtain specified voltage.
4. Starter motor should rotate smoothly at the specified speed, voltage, and current draw given at the beginning of this group.



Make No-Load Test

A—Battery
B—Ammeter
C—Shunt
D—Switch
E—Voltmeter
F—Starter Motor
G—Tachometer
H—Carbon Pile Resistor

RG,RG34710,2252 –19–15MAR97–1/1

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B97 –19–08MAY02–1/5

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUO1004,0000B97 –19–08MAY02–2/5

Alternator, Generator, Starter and Battery Bench Tester. JT01760

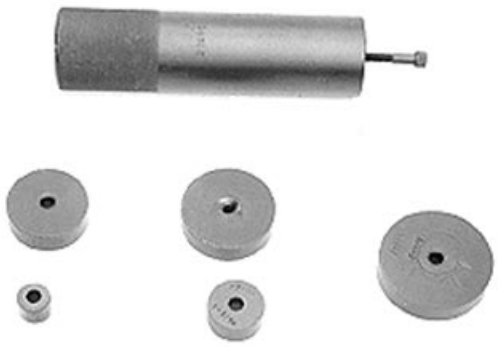
Test alternators and starters for voltage, resistance, or current flow.

Continued on next page

OUO1004,0000B97 –19–08MAY02–3/5

Bushing, Bearing and Seal Driver Set D01045AA

Install commutator end frame bushing.



RG11162 –UN–21SEP00

D01045AA

OUO1004,0000B97 –19–08MAY02–4/5

Blind Hole Puller Set D01061AA

Remove commutator end frame bushing.

RG11161 –UN–21SEP00

D01061AA

OUO1004,0000B97 –19–08MAY02–5/5

Other Material

Number	Name	Use
	Mineral Spirits	Clean armature, solenoid and brushes.
	00 Sandpaper	Clean commutator.
	ESSO Beacon 325 or Delco-Remy No. 1960954 Lubricant	Lubricate various stator components.

OUO1004,0000B99 –19–25SEP00–1/1

Delco-Remy 40MT, 41MT, 42MT, and 50MT Starter Motor Repair Specifications

Item	Measurement	Specification
Field Pole Shoe Cap Screws	Torque	41 N•m (30 lb-ft)
New Brush	Length	19 mm (0.75 in.)
Used Brush	Minimum Length	16 mm (0.63 in.)
Brush Spring	Minimum Tension	22 N (80 ounce-force)
Starter Motor Drive Housing Bushing (40MT, 41MT, 42MT)	ID Maximum Serviceable ID	15.88—15.93 mm (0.625—0.627 in.) 16.18 mm (0.637 in.)
Starter Motor Lever Housing Bushing (40MT, 41MT, 42MT)	ID Maximum Serviceable ID	24.46—24.51 mm (0.963—0.965 in.) 24.69 mm (0.972 in.)
Starter Motor Commutator End Frame Bushing (40MT, 41MT, 42MT)	ID Maximum Serviceable ID	16.87—16.97 mm (0.664—0.668 in.) 17.22 mm (0.678 in.)
Starter Motor Drive Housing Bushing (50MT)	ID Wear Tolerance Oil Clearance Wear Tolerance	15.88—15.90 mm (0.6250—0.6260 in.) 16.15 mm (0.636 in.) 0.05—0.10 mm (0.0020—0.0040 in.) 0.38 mm (0.0150 in.)
Starter Motor Lever Housing Bushing (50MT)	ID Wear Tolerance Oil Clearance Wear Tolerance	21.41—21.44 mm (0.8430—0.8440 in.) 21.59 mm (0.850 in.) 0.48—0.53 mm (0.0190—0.0210 in.) 0.69 mm (0.0270 in.)
Starter Motor Commutator End Frame Bushing (50MT)	ID Wear Tolerance Oil Clearance Wear Tolerance	14.27—14.30 mm (0.5620—0.5630 in.) 14.55 mm (0.5730 in.) 0.05—0.10mm (0.0020—0.0040 in.) 0.38 mm (0.0150 in.)
Shift Lever Housing Cap Screws	Torque	18—23 N•m (159—204 lb-in.)
Drive End Housing Cap Screws	Torque	18—23 N•m (159—204 lb-in.)
Commutator End Frame Cap Screws	Torque	18—23 N•m (159—204 lb-in.)
Pinion-to-Drive Housing	Clearance	8.33—9.92 mm (0.328—0.391 in.)

OUO1004,0000B9A –19–25SEP00–1/1

Delco-Remy 40MT, 41MT, 42MT, and 50MT Starter Motor Test Specifications

				No Load Test (Includes Solenoid Current)	
John Deere Starter Motor Part No.	Delco-Remy Starter Motor Model No. -Series	System Voltage	Motor Voltage	Current Draw (Amps)	Armature RPM
AM3397T	1107165	6	5.6	70	5500
AR102188	1114831-40MT	12	10	140—215	4000—7000
AR102190	1109841-50MT	24	20	80—125	5500—8500
AR102770	1114869-40MT	24	20	95—120	5500—7500
AR102771	1114843-40MT	24	20	70—110	5500—9000
AR46886	1114191-40MT	12	9	140—215	4000—7000
AR55313	1114735-40MT	24	20	70—110	5500—9000
AR55314	1113827-40MT	24	20	75—95	5500—7500
AR62153	1114166-40MT	12	11	160—230	4900—8300
AR72308	1113093	12	9	50—70	3500—5500
AR78235	1109978-50MT	24	20	95—120	5500—7500
AT16311	1107326	12	9	55—80	3500—6000
AT16882	1108093	6	5.7	90—125	4500—6400
AT409T	1107166	12	10	115—170	6600—9000
RE10321	1114819-40MT	12	10	140—215	4000—7000
RE10464	1990269-50MT	24	20	95—120	5500—7500
RE12101	1990270-50MT	24	20	95—120	5500—7500
RE13942	1990325-40MT	12	10	140—215	4000—7000
RE24305	1990354-42MT	12	10	115—170	6600—9000
RE28781	1990356-42MT	12	10	100—170	5500—7800
RE28782	1990357-42MT	24	20	60—75	6500—7700
RE28783	1990358-42MT	12	10	100—170	5500—7800
RE38632	1993917-37MT, 10479178-37MT	24	20		
RE38633	1993935-42MT	12	10	115—170	6600—9000
RE38634	1993936-42MT	24	20	50—90	6300—8400
RE41756	1190325-42MT	12	10	140—215	4000—8300
RE51792	1993934-42MT	12	10	115—170	6600—9000
RE59593	10478957-41MT	12	11		
RE61547	10479052-42MT	12	11	100—170	5500—7800
RE62911	1049071-41MT	12	11	130—175	6100—8700
RE63094	10479053-42MT	24	23	60—75	6300—8400
RE64474	10479071-41MT	12	11	130—175	6100—8700
RE65103	10479628	12	10.6	135—190	3600—5600

Continued on next page

				No Load Test (Includes Solenoid Current)	
John Deere Starter Motor Part No.	**Delco-Remy Starter Motor Model No. -Series**	**System Voltage**	**Motor Voltage**	**Current Draw (Amps)**	**Armature RPM**
RE67432	10479098-41MT	12	11	130—175	6100—8700
RE69590	1193935-42MT	12	10	115—170	6600—9000

RG,RG34710,2256 –19–07JUL05–2/2

Diagnosing Starter Motor Malfunctions

Fails to Operate, No Current Draw

Open field circuit (all field windings)

Open armature windings

Defective brush contact with commutator

Open solenoid windings

Defective solenoid contacts

Fails to Operate, High Current Draw

Grounded field windings or armature windings

Seized bearings

Low Speed, Low Current Draw

High internal resistance

Defective brush contact with commutator

Low Speed, High Current Draw

Excessive friction

Shorted armature

Grounded armature or field windings

High Speed, High Current Draw

Shorted field windings

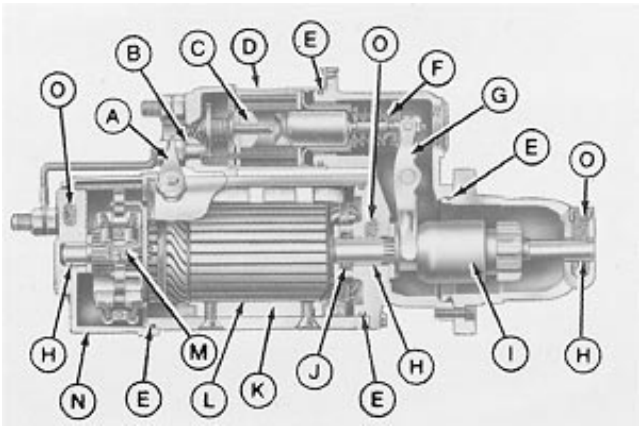
NOTE: This test will not detect individual open-circuited field coils—the stator would have a slow cranking speed but would pass this test.

RG,RG34710,2258 –19–15MAR97–1/1

Delco-Remy Starter Motor Cutaway View—Series 40MT, 41MT, 42MT, and 50MT

IMPORTANT: Never operate starter motor more than 30 seconds. Allow at least 2 minutes for cooling and battery recovery before operating again. Overheating, caused by excessive operation, will seriously damage starter motor.

NOTE: Series 42MT starter motors use TORX® screws for all external fasteners. Two different size TORX® drivers are required to service the motor—T40 and E8. These drivers can be procured from a local tool source.



RG4994 –UN–19JAN90

Series 42MT Shown

A—Field Connectors
B—Gasket
C—Bushing
D—Solenoid
E—O-Ring
F—Boot
G—Shift Lever
H—Bushing
I—Overrunning Clutch
J—Seal
K—Field Coil
L—Armature
M—Brushes
N—End Cap
O—Oil Wick

TORX is a registered trademark of Camcar/Textron.

RG,RG34710,2259 –19–12SEP02–1/1

Test Starter Motor Before Disassembly

1. Turn overrunning clutch pinion by hand. Clutch pinion should turn freely on shaft in overrunning direction only.

R78220Q1 –UN–23JAN90

Turn Overrunning Clutch Pinion

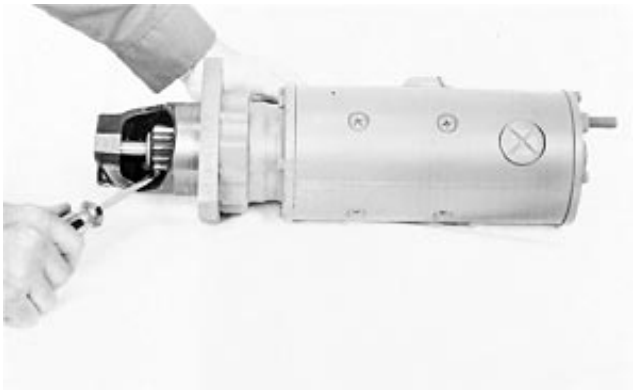
Continued on next page

RG,RG34710,2260 –19–15MAR97–1/5

2. Turn armature by prying against pinion with screwdriver. Check for dragging armature, seized bushings or bent shaft.

   If you discover any interference, disassemble and repair starter motor.

NOTE: Do not conduct the no-load test unless armature turns freely.



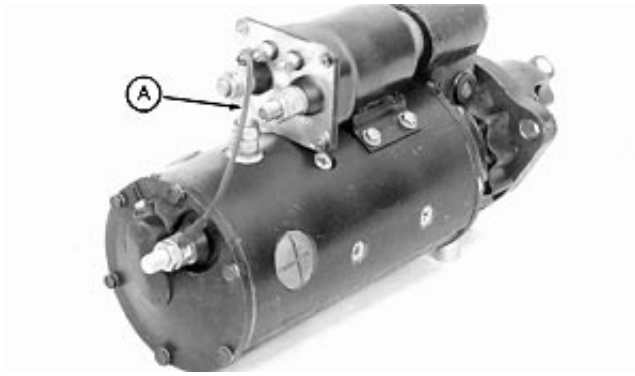
R78220R1 –UN–23JAN90

Turn Armature

RG,RG34710,2260 –19–15MAR97–2/5

3. Be sure solenoid ground wire (A) is connected securely to starter end frame.

A—Solenoid Ground Wire



RG3422 –UN–25SEP89

Solenoid Ground Wire

RG,RG34710,2260 –19–15MAR97–3/5

4. Connect a 12-volt battery to solenoid with heavy-duty jumper cables. Connect battery terminal on solenoid to positive (+) battery terminal. Connect motor terminal to negative (-) battery terminal.

RG3423 –UN–31JUL89

Connect 12-Volt Battery

Continued on next page

RG,RG34710,2260 –19–15MAR97–4/5

IMPORTANT: DO NOT engage solenoid longer than one or two seconds, because closing solenoid switch provides a dead short across battery.

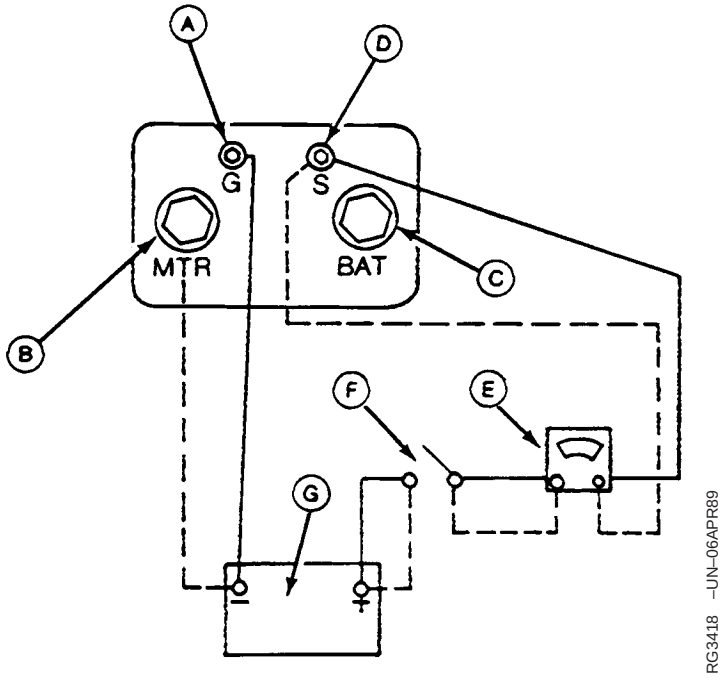
5. Use a screwdriver to short across from battery terminal to switch terminal. Solenoid should engage, pushing overrunning clutch drive to engaged position.

   When screwdriver is removed, solenoid should return sharply to the disengaged position. If solenoid engages, but then chatters instead of staying firmly engaged, hold-in winding is defective and solenoid must be replaced. Be sure solenoid and ground wire are connected securely to starter frame. If shift lever or overrunning clutch drive appears to bind, disassemble and repair starter.

Use Screwdriver

RG,RG34710,2260 –19–15MAR97–5/5

Test Pull-In and Hold-In Windings



Exploded View

A—Ground Terminal
B—Motor Terminal
C—Battery Terminal
D—Switch Terminal
E—Ammeter
F—Switch
G—24-Volt Battery

1. (See exploded view in this group.) Remove field coil connector (42) and return wire (31).

2. Make connections shown by dashed lines for testing pull-in windings.

IMPORTANT: DO NOT energize pull-in windings longer than 15 seconds. Current draw will decrease as winding temperature increases, which could damage windings.

3. Close switch (F) and observe ammeter (E). Ammeter should read 24—28 amps for 24-volt motors and 55—63 amps for 12-volt motors.

4. Make connections shown by solid lines for testing hold-in windings.

5. Close switch and observe ammeter. Ammeter should read 4.1 amps maximum for 24-volt motors and 6—9 amps for 12-volt motors.

6. Interpret test results as follows:

High Ammeter Reading

Windings are grounded or short circuited.

Low Ammeter Reading

Excessive resistance is present (usually in a connection).

No Ammeter Reading

Windings are open circuited.

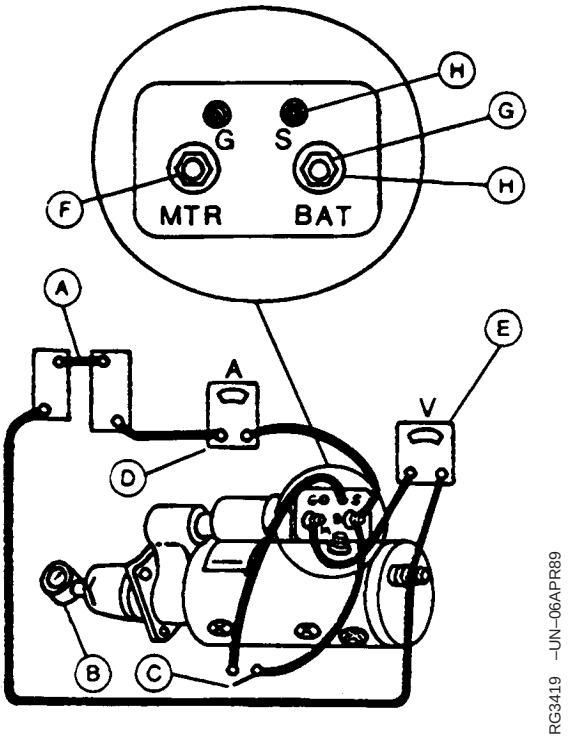
NOTE: If the fault cannot be repaired and the solenoid performance is questionable, replace the windings.

RG,RG34710,2261 –19–09OCT00–1/1

Make No-Load Test

1. Install field connector and connect solenoid return lead.
2. Make connections as shown. Use an ammeter capable of measuring at least 300 amps.
3. Close switch to operate starter. Compare rpm and current draw with specifications given at beginning of this group.

   Battery voltage will drop due to high current draw. If speed and current draw are slightly low, repeat test, observing voltmeter. Voltage may be reduced due to high current draw.



Make No-Load Test

A—Batteries
B—Tachometer
C—Switch
D—Ammeter
E—Voltmeter
F—To Voltmeter
G—To Ammeter
H—To Switch

Interpret test results as follows:

Fails to Operate, No Current Draw

Open field circuit (all field windings)

Open armature windings

Defective brush contact with commutator

Fails to Operate, High Current Draw

Grounded terminal or field windings

Seized bearings

Low Speed, Low Current Draw

High internal resistance

Defective brush contact with commutator

Low Speed, High Current Draw

Excessive friction

Shorted armature

Grounded armature or field windings

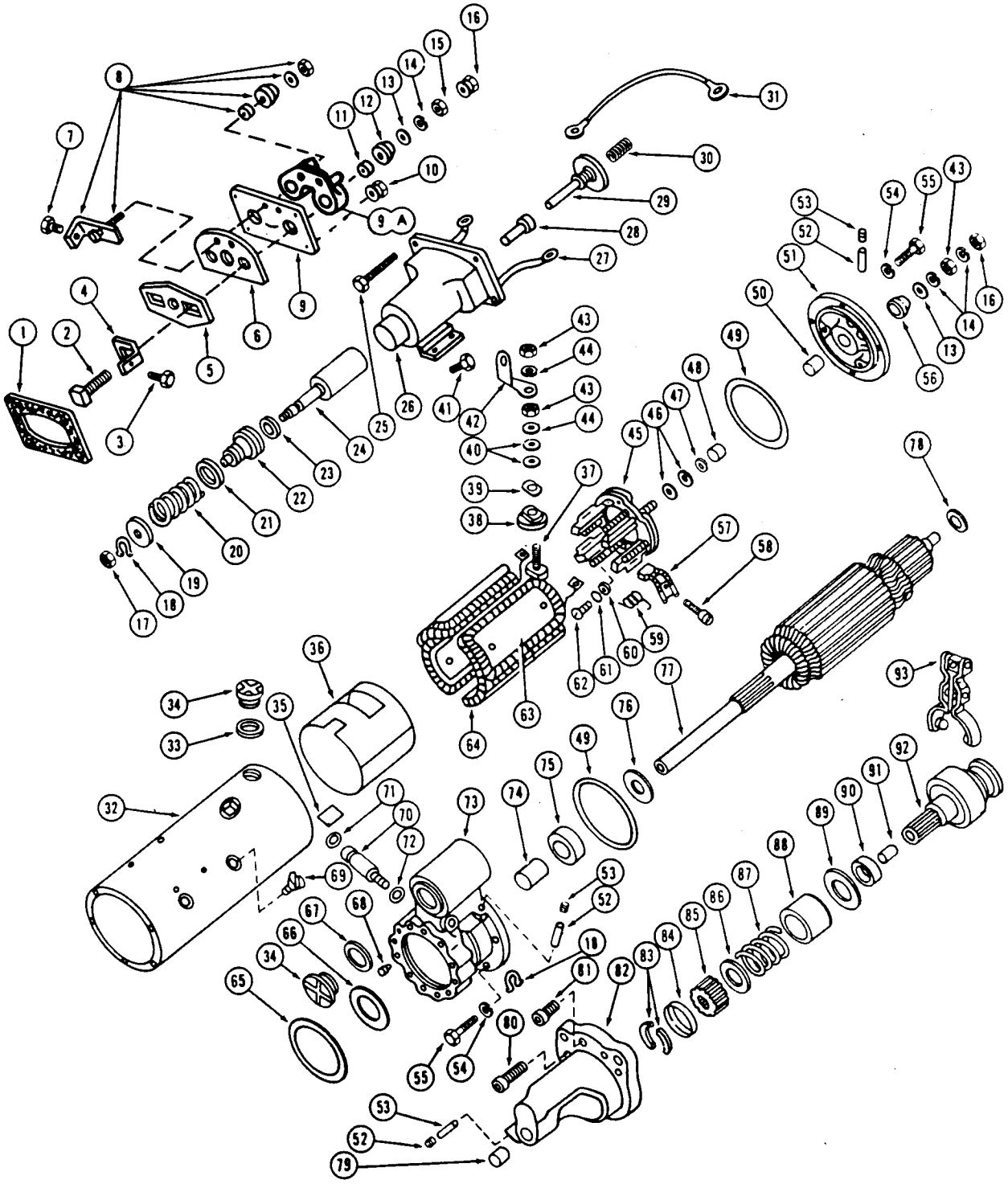
High Speed, High Current Draw

Shorted field windings

RG,RG34710,2262 –19–15MAR97–1/1

60
20
12

Disassemble Delco-Remy Starter Motor (Series 50MT Illustrated)



RG4278 –UN–03SEP91

Delco-Remy Starter Motor (50MT)

Continued on next page

RG,RG34710,2263 –19–12SEP02–1/9

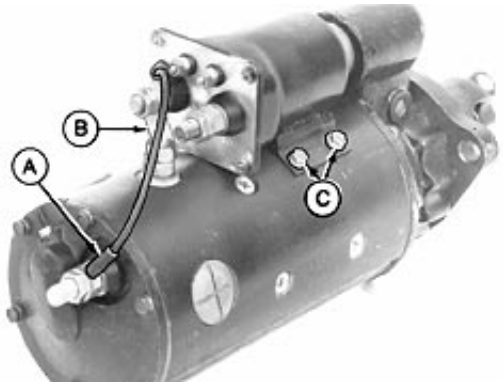
1—Terminal Plate Gasket
2—Terminal Stud (2 Used)
3—Machine Screw (2 Used)
4—Solenoid Winding Terminal
5—Strip Insulator
6—Insulator
7—Screw (4 Used)
8—Terminal
9—Plate
9A—Solenoid Cover
10—Nut (4 Used)
11—Washer (2 Used)
12—Lock Washer Insulator (2 Used)
13—Washer (2 Used)
14—Lock Washer (2 Used)
15—Nut (2 Used)
16—Nut (2 Used)
17—Lock Nut
18—Snap Ring
19—Retainer
20—Spring
21—Retainer
22—Boot
23—Washer
24—Plunger
25—Screw (4 Used)
26—Solenoid Winding and Case Assembly
27—Wiring Lead
28—Bushing
29—Disk
30—Spring
31—Solenoid Return Wire
32—Field Frame
33—Brush Plug Gasket (2 Used)
34—Plug (3 Used)
35—Field Lead Insulator (2 Used)
36—Field Coil and Brush Lead Insulator
37—Field Terminal Stud
38—Insulator
39—Special Packing
40—Insulating Washers 25 mm (1 in.) OD (2 Used)
41—Solenoid Mounting (4 Used)
42—Field Coil Connector
43—Jam Nut (3 Used)
44—Washer (2 Used)
45—Brush Holder Assembly
46—Insulating Washers 2 mm (7/8 in.) OD (2 Used)
47—Packing
48—Insulator Bushing
49—O-Ring (2 Used)
50—Commutator End Frame Bushing
51—Commutator End Frame
52—Lubrication Wick (3 Used)
53—Plug (3 Used)
54—Lock Washer (9 Used)
55—Special Hex Screw (9 Used)
56—Insulator
57—Brushes (4 Used)
58—Machine Screw (4 Used)
59—Spring (4 Used)
60—Plain Washer (3 Used)
61—Lock Washers (3 Used)
62—Machine Screw (3 Used)
63—Field Pole Shoe (4 Used)
64—Field Coil Assembly
65—Gasket
66—Brake Washer
67—Adjusting Hole Plug Gasket
68—Seal Plug
69—Pole Shoe Screw (8 Used)
70—Shift Lever Shaft
71—O-Ring
72—Small O-Ring
73—Shift Lever Housing
74—Lever Housing Bushing
75—Oil Seal
76—Spacer Washer
77—Armature
78—Thrust Washer
79—Drive End Housing Bushing
80—Special Screw 38 mm (1-1/2 in.) Long (5 Used)
81—Special Screw 22 mm (7/8 in.) Long (2 Used)
82—Drive End Housing
83—Split Washer (2 Used)
84—Pinion Stop Cup
85—Pinion
86—Small Washer
87—Spring
88—Spring Cup
89—Large Washer
90—Spacer
91—Overrunning Clutch Bushing
92—Overrunning Clutch
93—Shift Lever

60
20
13

RG,RG34710,2263 –19–12SEP02–2/9

1. Disconnect solenoid ground wire (A).
2. Remove field winding connector (B).
3. Remove solenoid mounting cap screws (C).

A—Solenoid Ground Wire
B—Field Winding Connector
C—Solenoid Mounting Cap Screws



RG3427 –UN–31JUL89

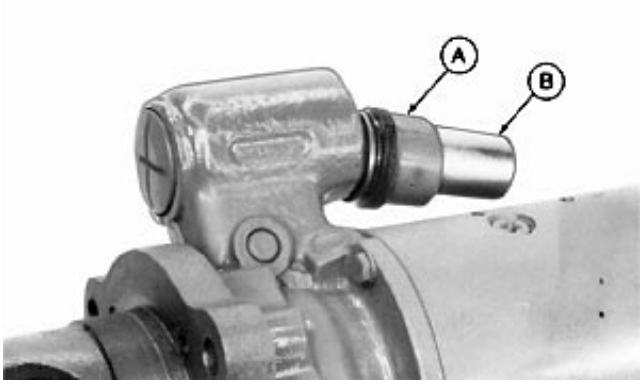
Disassemble Starter Motor

Continued on next page

RG,RG34710,2263 –19–12SEP02–3/9

4. Push boot (A) back, and slide solenoid away (shown removed) from boot and plunger (B).

A—Boot
B—Plunger



RG3428 –UN–31JUL89

Push Boot Back

RG,RG34710,2263 –19–12SEP02–4/9

5. IF NECESSARY, remove cover plug and disconnect solenoid plunger from shift lever. Grasp plunger and remove self-locking nut as shown.

NOTE: Pinion clearance is controlled by self-locking nut. Do not change adjustment unless complete disassembly is required. Check pinion clearance as covered later in this group.

R78220T1 –UN–23JAN90

Remove Self-Locking Nut

Continued on next page

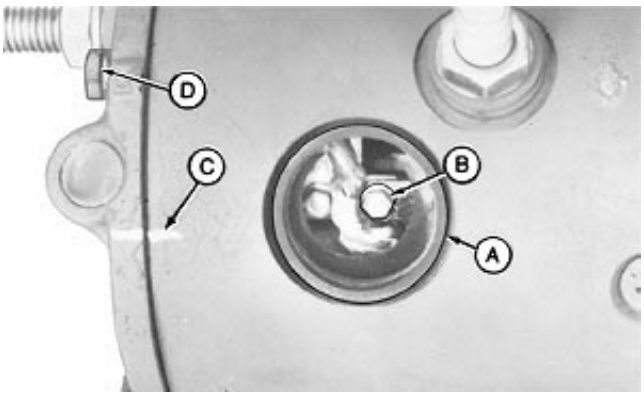
RG,RG34710,2263 –19–12SEP02–5/9

6. Remove field brush cover plugs (shown removed) and O-rings (A). Remove screws (B) from field winding leads.

NOTE: Scribe reference marks (C) across end frame and field frame for reassembly.

7. Remove end frame cap screws (D).

A—O-Ring (2 Used)
B—Cap Screw (2 Used)
C—Reference Marks
D—Cap Screw (4 Used)



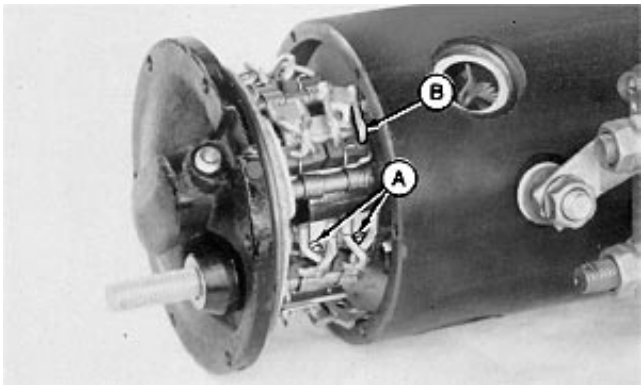
Brush Cover Plugs Shown Removed

RG,RG34710,2263 –19–12SEP02–6/9

8. Carefully slide brush holder assembly away from armature. Remove brush strap machine screws (A). Inspect brush leads (B) for fraying or discoloration.

NOTE: If only brushes are going to be installed, it is not necessary to remove brush holder assembly.

A—Brush Strap Machine Screws
B—Brush Leads



Slide Brush Holder Assembly

Continued on next page

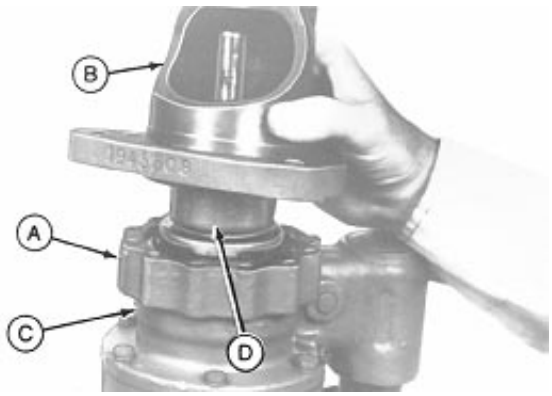
RG,RG34710,2263 –19–12SEP02–7/9

9. Scribe a reference mark (A) across drive housing (B) and shift lever housing (C) for proper assembly.

10. Remove drive end housing cap screws and remove drive housing.

11. Remove shift lever housing with overrunning clutch (D).

A—Reference Mark
B—Drive End Housing
C—Shift Lever Housing
D—Overrunning Clutch



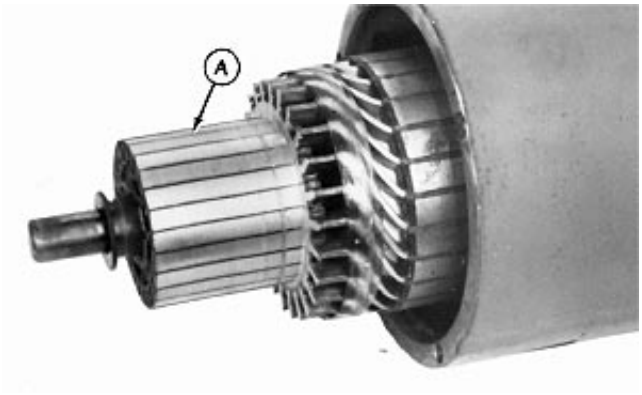
RG3431 –UN–31JUL89

Remove Shift Lever Housing

RG,RG34710,2263 –19–12SEP02–8/9

12. Carefully slide armature (A) out. If spacer washer remains in housing, pull it out and install on shaft.

A—Armature



RG3432 –UN–31JUL89

Armature

RG,RG34710,2263 –19–12SEP02–9/9

Make Ground Circuit Test for Field Windings

1. Set the D09001TT Volt-Ohm-Amp Meter to read on highest scale.
2. Place one test lead on a clean spot on field frame. Place other lead on the copper terminal bolt.

   If the ohmmeter indicator swings toward zero, a grounded circuit is indicated. Replace the field windings.

Volt-Ohm-Amp Meter

RG780760Q1 –UN–09JAN90

60
20
17

RG,RG34710,2264 –19–15MAR97–1/1

Make Open Circuit Test for Shunt Windings

1. Set ohmmeter on its lowest scale.
2. Place one test lead on the eyelet terminal. Place other lead on the terminal bolt.
3. If the ohmmeter does not swing to zero, it is open circuited. Replace the field winding assembly.

RG,RG34710,2265 –19–15MAR97–1/1

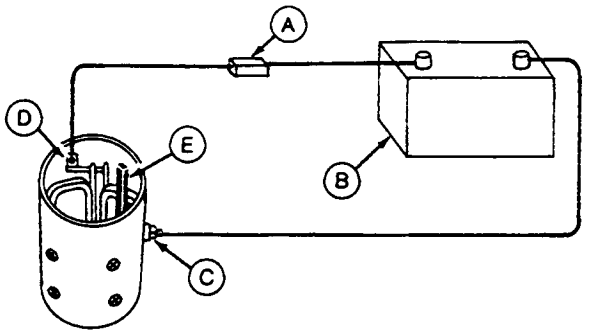
Make Open Circuit Test for Field Windings

All four field windings are connected in parallel. Test each winding for an open circuit.

1. Connect a test battery (B) to field terminal (C) and to either insulated brush lead (D) using a resistor (A) to limit current draw.
2. Use a hacksaw blade (E) to test windings for magnetism. If any winding is not magnetic, the winding is open circuited. Repair or replace windings.

NOTE: Because 1/4 ohm resistors capable of carrying several hundred watts are not widely available, a suggested alternative is to connect four 1-ohm resistors in parallel. Each resistor should be rated for at least 150 watts. A carbon pile resistor can also be used. Limit current to 40—70 amps.

There is no suitable way to check field windings for short circuits. Winding resistance is too low to permit detection of a short circuit.



R265544N –UN–11APR89

Make Open Circuit Test

A—1/4-Ohm Resistor
B—12-Volt Battery
C—Field Terminal
D—Insulated Brush Lead
E—Hacksaw Blade

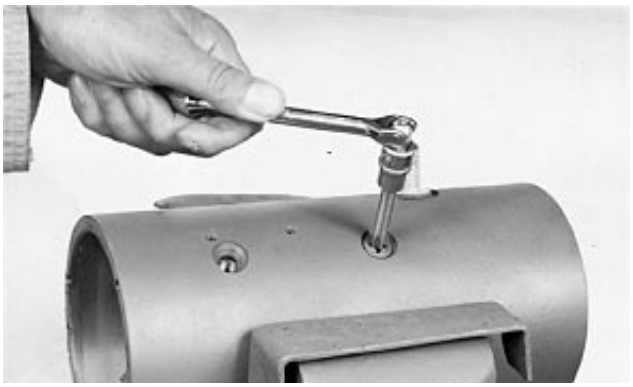
RG,RG34710,2266 –19–09OCT00–1/1

Remove Field Windings

1. If field windings are suspected of being damaged, place field frame in a soft-jawed vise.

NOTE: Do not squeeze sides of field frame in vise or strike with a hammer. If an impact screwdriver is used to remove pole shoe screws, support each pole shoe individually using a pole shoe spreader or the nose of an anvil.

2. Use a large screwdriver or bit and socket wrench on pole shoe screws.



R782211I –UN–23JAN90

Field Frame in Vise

Continued on next page

RG,RG34710,2267 –19–15MAR97–1/2

3. Remove pole shoes. Then carefully remove field windings as an assembly.

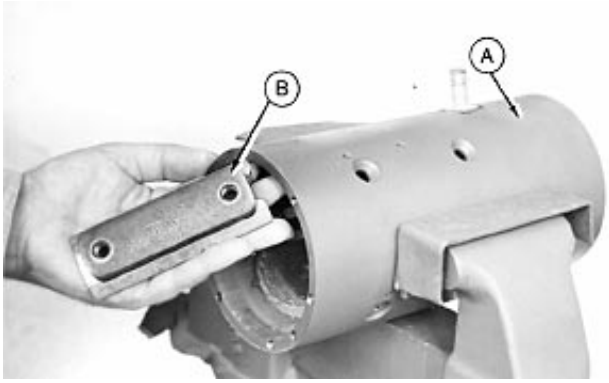
IMPORTANT: Handle windings very carefully. Windings are easily damaged, causing shorts, opens, or grounds.

4. Install new field windings and tighten pole shoe screws to specifications. Use a center punch to lightly stake one edge of each screw.

Specification

Field Pole Shoe Cap Screws—
Torque ..... 41 N•m (30 lb-ft)

IMPORTANT: Make sure the notched end (B) on pole shoe is facing the brush end of the field frame (A).



R78221H1 –UN–23JAN90

Notched End Facing Brush End

A—Field Frame
B—Notched End on Pole Shoes

60
20
19

RG,RG34710,2267 –19–15MAR97–2/2

Inspect Brushes

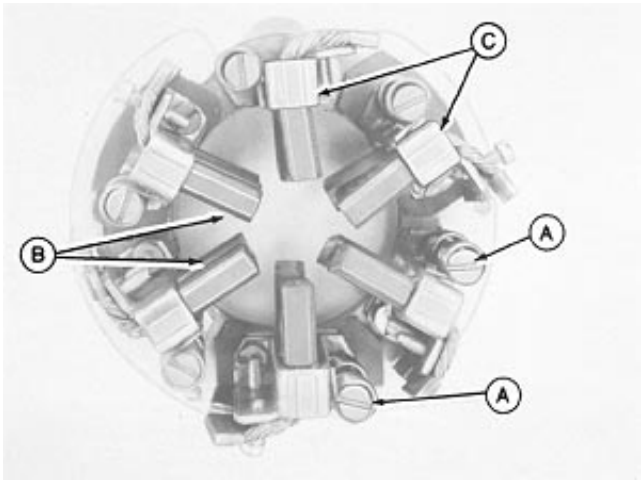
1. Remove brushes (B) by lifting brush up and away from brush spring (A).

2. Replace brushes if they are oil soaked, worn, pitted, or damaged. If brushes are worn beyond specification, replace them.

Specification

New Brush—Length ..... 19 mm (0.75 in.)
Used Brush—Minimum Length ..... 16 mm (0.63 in.)

3. Make sure brush holders (C) are clean and brushes are not binding in holders. The full brush surface should ride on the commutator.



RG3421 –UN–31JUL89

Inspect Brushes

A—Brush Spring
B—Brushes
C—Brush Holders

RG,RG34710,2268 –19–15MAR97–1/1

Test Brush Holder for Ground

1. Set ohmmeter on its highest scale.
2. Place one test lead on commutator end frame. Place other lead on brush holder.

   If dial indicator swings toward zero, the positive brush holder is grounded and should be replaced.

RG,RG34710,2269 –19–15MAR97–1/1

Inspect Brush Springs

1. Inspect and replace brush springs if they are distorted or discolored.
2. Measure brush spring tension with a spring scale.

Specification

Brush Spring—Minimum Tension..... 22 N (80 ounce-force)

RG,RG34710,2270 –19–15MAR97–1/1

Install New Bushings—40MT, 41MT, and 42MT

NOTE: See exploded view earlier in this group.

1. Remove all plugs (53) and lubricating wick (52).

2. Replace bushings if worn beyond specification.

Specification

Starter Motor Drive Housing Bushing (40MT, 41MT, 42MT)—ID ..... 15.88—15.93 mm (0.625—0.627 in.)
Maximum Serviceable ID ..... 16.18 mm (0.637 in.)
Starter Motor Lever Housing Bushing (40MT, 41MT, 42MT)—ID ..... 24.46—24.51 mm (0.963—0.965 in.)
Maximum Serviceable ID ..... 24.69 mm (0.972 in.)
Starter Motor Commutator End Frame Bushing (40MT, 41MT, 42MT)—ID ..... 16.87—16.97 mm (0.664—0.668 in.)
Maximum Serviceable ID ..... 17.22 mm (0.678 in.)

NOTE: The overrunning clutch drive bushing (91) is not replaceable. Entire drive must be replaced if bushing is worn.

NOTE: When replacing lever housing bushing, seal plug (68, refer to exploded view) must be removed. Install new seal plug after replacing bushing.

3. Remove commutator end frame bushing using the D01061AA Blind Hole Puller Set.

4. Drive old bushing out and drive new bushing in to same depth as old bushing. Use the following disks from D01045AA Bushing, Bearing and Seal Driver Set.

Bushing Location	Pilot Disk	Disk Driver
Drive Housing	27492	27494
Lever Housing	27496	27498
Commutator	27491	27495

Continued on next page

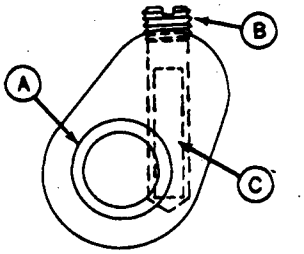
5. Use a drill the same size as the oil wick hole and drill bushing (A).

   Only if necessary, carefully ream bushing to size.

6. Saturate new wicks (C) with SAE 10W clean engine oil and install.

7. Install plug (B) and tighten securely.

A—Drill Bushing
B—Plug
C—Oil Wick



R25221 –UN–17APR89

Install Plug

RG,RG34710,2271 –19–09OCT00–2/2

Install New Bushings—50MT

NOTE: See exploded view earlier in this group.

1. Remove plugs (53) and lubricating wicks (52).

2. Replace bushings if worn more than wear tolerance given.

Specification	
Starter Motor Drive Housing	
Bushing (50MT)—ID	15.88—15.90 mm (0.6250—0.6260 in.)
Wear Tolerance	16.15 mm (0.636 in.)
Oil Clearance	0.05—0.10 mm (0.0020—0.0040 in.)
Wear Tolerance	0.38 mm (0.0150 in.)
Starter Motor Lever Housing	
Bushing (50MT)—ID	21.41—21.44 mm (0.8430—0.8440 in.)
Wear Tolerance	21.59 mm (0.850 in.)
Oil Clearance	0.48—0.53 mm (0.0190—0.0210 in.)
Wear Tolerance	0.69 mm (0.0270 in.)
Starter Motor Commutator End	
Frame Bushing (50MT)—ID	14.27—14.30 mm (0.5620—0.5630 in.)
Wear Tolerance	14.55 mm (0.5730 in.)
Oil Clearance	0.05—0.10mm (0.0020—0.0040 in.)
Wear Tolerance	0.38 mm (0.0150 in.)

NOTE: The overrunning clutch drive bushing (91) is not replaceable. Entire drive must be replaced if bushing is worn.

NOTE: When replacing lever housing bushing, seal plug (68, refer to exploded view) must be removed. Install new seal plug after replacing bushing.

3. Remove commutator end frame bushing using the D01061AA Blind Hole Puller Set.

4. Drive old bushing out and drive new bushing in to same depth as old bushing. Use the following disks from D01045AA Bushing, Bearing and Seal Driver Set.

Continued on next page

Bushing Location	Pilot Disk	Disk Driver
Drive Housing	27492	27494
Lever Housing	27496	27498
Commutator	27491	27495

RG,RG34710,2272 –19–09OCT00–2/3

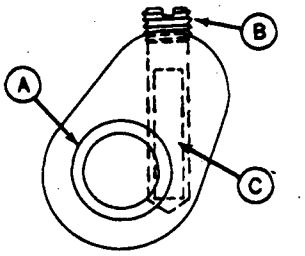
5. Use a drill the same size as the oil wick hole and drill bushing (A).

   Only if necessary, carefully ream bushing to size.

6. Saturate new wicks (C) with SAE 10W clean engine oil and install.

7. Install plug (B) and tighten securely.

A—Drill Bushing
B—Plug
C—Oil Wick



R25221 –UN–17APR89

Install Plug

RG,RG34710,2272 –19–09OCT00–3/3

Clean Starter Motor Components

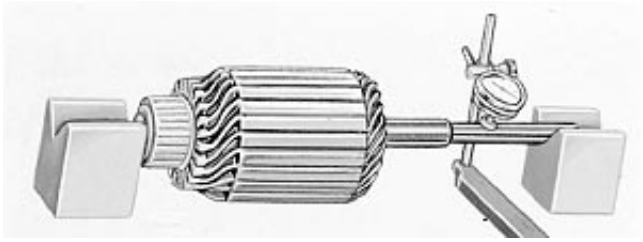
IMPORTANT: Never clean armature, field windings, or overrunning clutch drive in solvent. All parts except overrunning clutch drive may be cleaned with mineral spirits and a brush.

1. Clean components using mineral spirits and a brush.

2. Dry with compressed air or a clean cloth.

RG,RG34710,2273 –19–15MAR97–1/1

Inspect Armature


X1451 –UN–25JAN89

1. Place armature in V-blocks and check for a bent shaft. Replace armature if shaft is bent.
2. Inspect armature for signs of dragging against pole shoes or scoring under bushings.
3. Carefully check commutator for roughness, burned commutator bars or any material that might cause short circuits between bars.
4. Clean and touch up commutator, if necessary, with 00 sandpaper. NEVER use emery cloth.

NOTE: If commutator is out of round, badly burned or rough, it can be turned down slightly on a lathe. Remove only enough metal to eliminate problem. Do not undercut commutator after turning, as this will cause shorts between commutator bars.

60
20
25

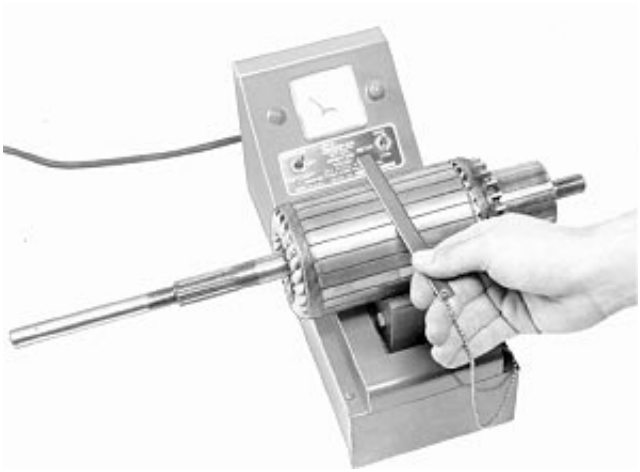
RG,RG34710,2274 –19–15MAR97–1/1

Make Short Circuit Test

Place armature in a growler and hold hacksaw blade above each slot while slowly rotating the armature.

If coil is shorted, the blade will be attracted to and repelled from the slot.

A short circuit most often occurs because of copper dust or filings between segments. Clean commutator segments to correct this short.


RG78074C1 –UN–09JAN90

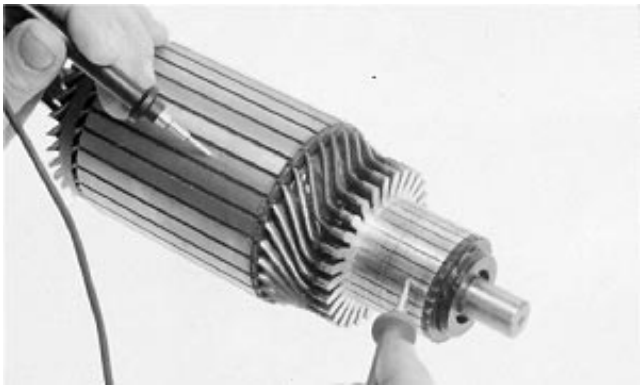
Make Short Circuit Test

RG,RG34710,2275 –19–15MAR97–1/1

Make Armature Ground Test

1. Set ohmmeter to read on highest scale.
2. Place one test lead on the armature core or shaft. Place other lead on commutator.

   If the test meter indicator swings toward zero, the armature is grounded. Replace armature.



Make Armature Ground Test

RG,RG34710,2276 –19–15MAR97–1/1

Make Open Circuit Test

1. Set ohmmeter to read on lowest scale.
2. Place one test lead on ohmmeter segment. Place other test lead on an adjacent segment.
3. Repeat this operation for all segments by moving one lead at a time.

   If the test meter indicator does not swing to zero and remains stationary, the armature coil between these two segments is open. Replace armature.

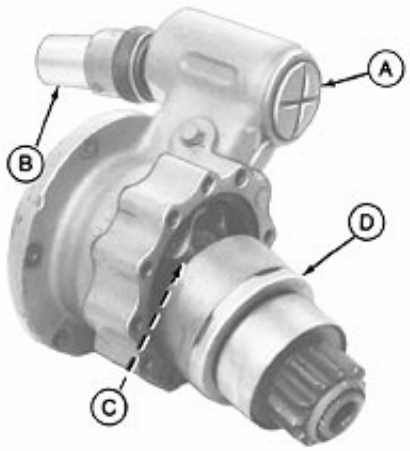
Make Open Circuit Test

RG,RG34710,2277 –19–15MAR97–1/1

Inspect Solenoid Plunger and Shift Lever Assembly

1. Remove plug (A) and inspect plunger and shift lever assembly for wear or damage.
2. Press plunger (B) inward and check tension on plunger spring. Spring should not compress easily. Replace plunger assembly if spring is weak.
3. Inspect shift lever wear pads (C) for wear or damage. If damaged, replace both wear pads.
4. Inspect overrunning clutch (D) for wear or damage. Replace as necessary.

A—Plug
B—Plunger
C—Wear Pads
D—Overrunning Clutch



RG3435 –UN–31JUL89

Solenoid Plunger/Shift Lever Assembly

RG,RG34710,2278 –19–15MAR97–1/1

Inspect Overrunning Clutch and Pinion

Rotate the pinion. Pinion gear should rotate smoothly (but not easily) in one direction. The pinion gear should not rotate in the opposite direction.

If pinion gear does not rotate smoothly or if it is worn, chipped, or burred, it should be replaced.

RG,RG34710,2279 –19–15MAR97–1/1

Inspect and Clean Solenoid

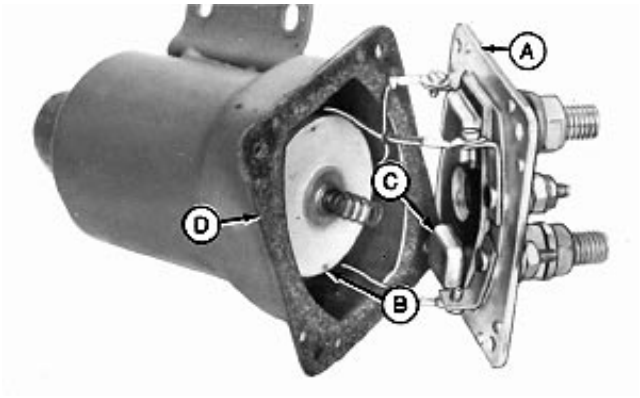
1. Remove terminal plate (A) and inspect all parts. Replace contact disk (B) and terminal studs (C), if they are badly corroded.

   Be sure all connections are clean and tight.

2. Replace gasket (D), if corroded or damaged.

3. Wipe parts with mineral spirits and brush. Dry with a clean cloth.

IMPORTANT: Solenoid contacts and plunger will be damaged if current is applied to solenoid when removed from starter motor.



RG3436 –UN–31JUL89

Inspect and Clean Solenoid

A—Terminal Plate
B—Contact Disk
C—Terminal Studs
D—Gasket

RG,RG34710,2280 –19–15MAR97–1/1

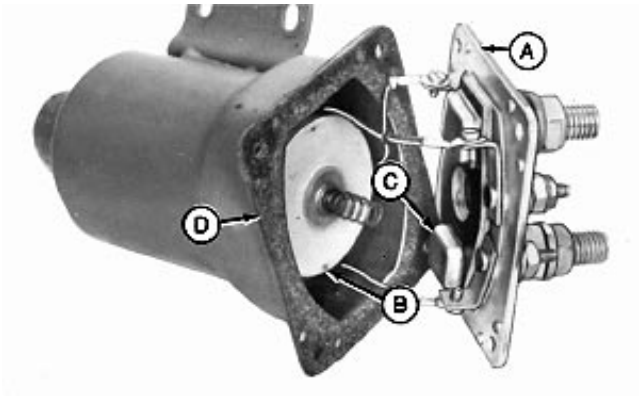
Assemble Solenoid

1. Place new gasket (D) on solenoid housing.

2. Align terminal studs (C) and contact disk (B).

3. Tighten terminal plate (A) cap screws securely.

A—Terminal Plate
B—Contact Disk
C—Terminal Studs
D—Gasket



RG3436 –UN–31JUL89

Assemble Solenoid

RG,RG34710,2281 –19–15MAR97–1/1

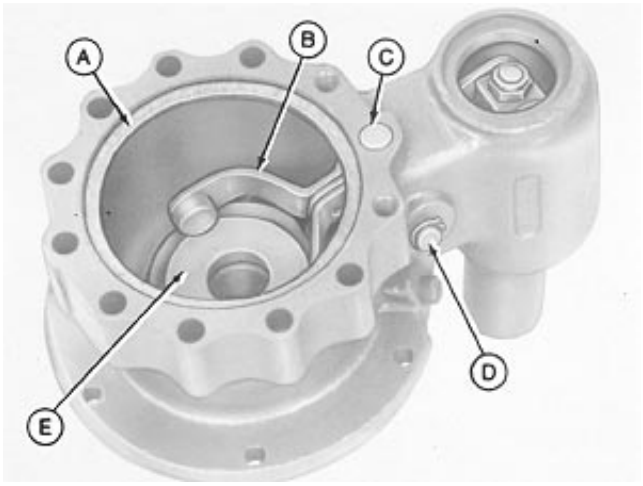
Assemble Starter Motor

NOTE: Always use new O-rings, packing, and gaskets when assembling starter motor.

1. Lubricate bearing surfaces with Delco-Remy No. 1960954 Lubricant or its equivalent.

2. Install seal plug (C), gasket (A), and brake washer (E) into shift lever housing.

A—Gasket
B—Shift Lever
C—Seal plug
D—Shift Lever Shaft
E—Brake Washer



RG3437 –UN–31JUL89

Shift Lever Housing

60
20
29

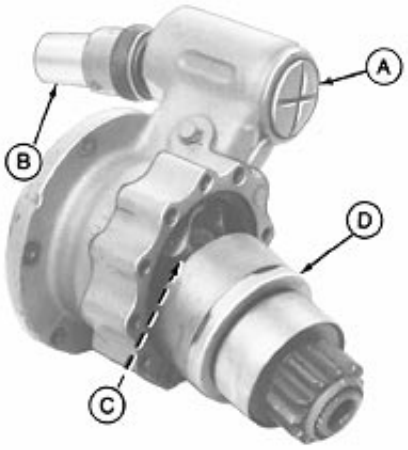
RG,RG34710,2282 –19–12SEP02–1/8

3. Install wear pads (C) and overrunning clutch (D).

4. Make sure plunger (B) moves shift lever back and forth easily.

NOTE: Do not install adjusting hole plug (A) until pinion clearance has been checked.

A—Adjusting Hole Plug
B—Plunger
C—Wear Pads
D—Overrunning Clutch



RG3435 –UN–31JUL89

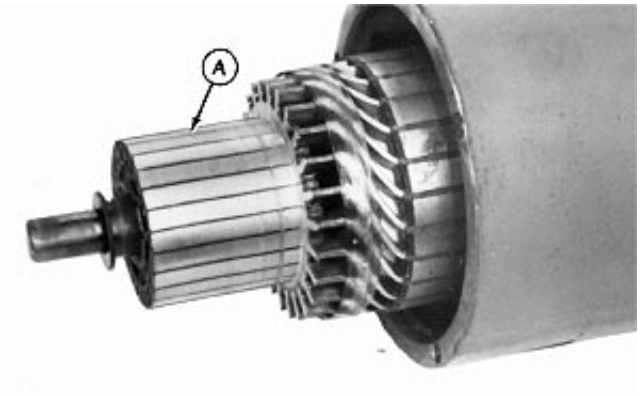
Shift Lever

Continued on next page

RG,RG34710,2282 –19–12SEP02–2/8

5. Carefully install armature (A) into field frame. Be sure spacer is installed on end of armature shaft before installing into main frame.

A—Armature



RG3432 –UN–31JUL89

Install Armature

RG,RG34710,2282 –19–12SEP02–3/8

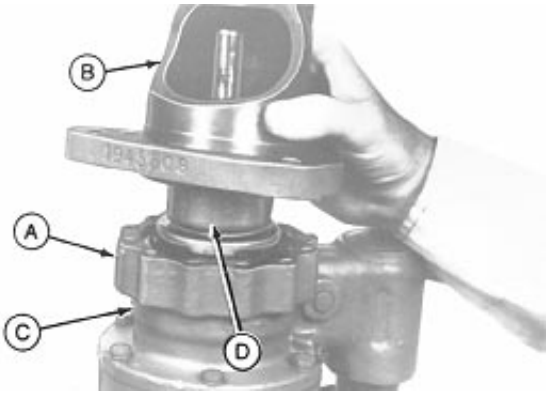
NOTE: Series 42MT starter motors have TORX® screws for all external fasteners. Tighten screws to same torque values as given for conventional screws.

6. Install shift lever housing (C), making sure armature shaft goes through overrunning clutch (D). Tighten cap screws to specifications.

Specification	
Shift Lever Housing Cap Screws—Torque	18—23 N•m (159—204 lb-in.)

7. Align reference marks (A) (made prior to disassembly) and install drive end housing (B). Make sure armature shaft fits through drive housing bushing. Tighten special screws to specifications.

Specification	
Drive End Housing Cap Screws—Torque	18—23 N•m (159—204 lb-in.)



RG3431 –UN–31JUL89

Install Shift Lever Housing

A—Reference Mark
B—Drive End Housing
C—Shift Lever Housing
D—Overrunning Clutch

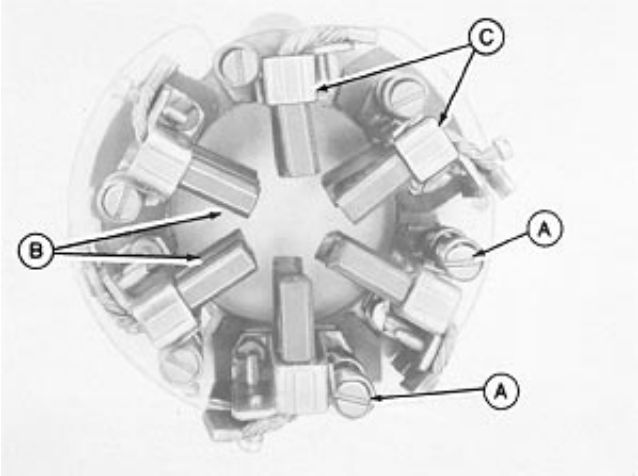
TORX is a registered trademark of Camcar/Textron.

Continued on next page

RG,RG34710,2282 –19–12SEP02–4/8

8. Pull brushes (B) up against brush holder (C) and spring (A). Pull brushes up far enough to allow installation of the commutator.

A—Spring
B—Brushes
C—Brush Holder



RG3421 –UN–31JUL89

Pull Brushes

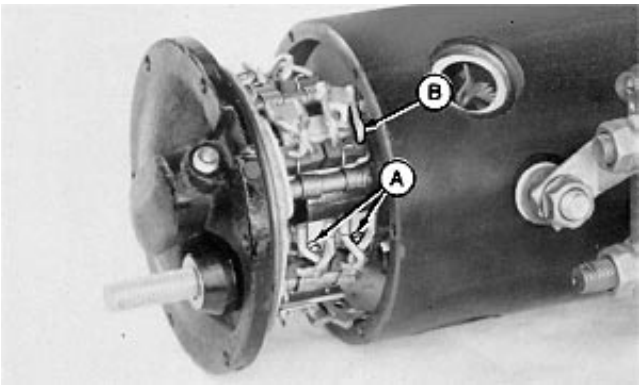
RG,RG34710,2282 –19–12SEP02–5/8

9. Install bush assembly onto commutator. Press brushes down until spring clips over brush.

10. Press brush leads (B) down onto brush holder. Be sure that the leads DO NOT touch each other.

11. Install brush strap machine screws (A), and tighten brush strap securely to brush holder.

A—Brush Strap Machine Screws
B—Brush Leads



RG3420 –UN–31JUL89

Install Bush Assembly

Continued on next page

RG,RG34710,2282 –19–12SEP02–6/8

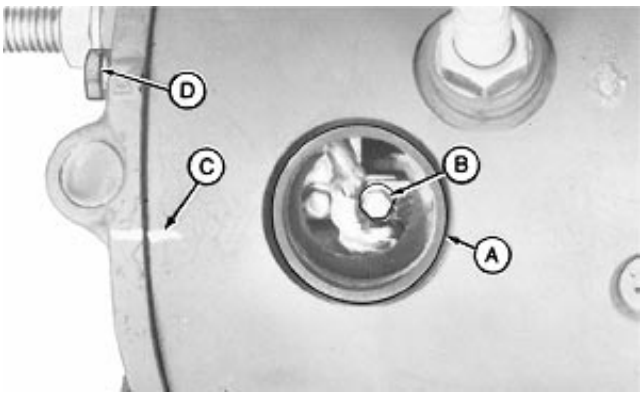
12. Carefully press brush assembly and end frame into main frame and align reference mark (C) (made prior to disassembly).

13. Install O-ring (A) and install field winding lead-to-brush holder machine screws (B). Tighten cap screws securely. Install field brush cover plugs (shown removed).

14. Install commutator end frame cap screws and tighten to specifications.

Specification

Commutator End Frame Cap Screws—Torque ..... 18—23 N•m (159—204 lb-in.)



RG3429 –UN–31JUL89

Bush Assembly and End Frame

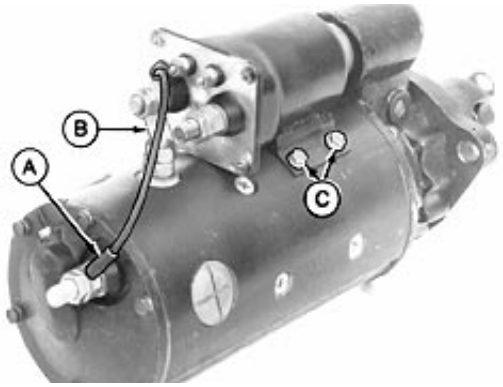
A—O-Ring (2 Used)
B—Machine Screw (2 Used)
C—Reference Marks
D—Cap Screw (4 Used)

RG,RG34710,2282 –19–12SEP02–7/8

15. Install solenoid. Be sure plunger and boot are installed correctly. Tighten solenoid-to-field frame cap screws (C) securely.

16. Install solenoid ground wire (A) and field winding connector (B). Tighten all connections securely.

A—Solenoid Ground Wire
B—Field Winding Connector
C—Solenoid-to-Field Frame Cap Screws



RG3427 –UN–31JUL89

Install Solenoid

RG,RG34710,2282 –19–12SEP02–8/8

Check for Proper Pinion Clearance

1. Disconnect solenoid ground wire and connect a 12-volt battery to solenoid “SW” and ground terminals.

2. Briefly touch a screwdriver blade across motor and ground terminals to pull solenoid plunger in.


RG3424 –UN–31JUL89

Screwdriver Blade

Continued on next page

RG,RG34710,2283 –19–15MAR97–1/2

3. Push pinion back toward armature (arrow).

4. Measure distance between pinion (C) and drive housing.

   Correct pinion clearance (E) is as follows:

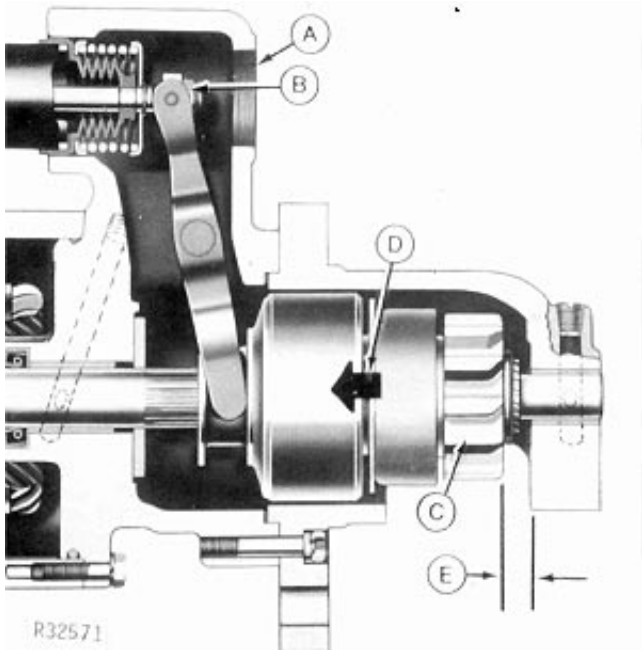
Specification

Pinion-to-Drive Housing—
Clearance ..... 8.33—9.92 mm (0.328—0.391 in.)

5. If pinion clearance is not within specifications, turn self-locking nut (B) to adjust clearance.

6. After adjusting to correct pinion clearance, install adjusting hole plug and tighten securely.

A—Plug Removed
B—Self-Locking Nut (Turn to Adjust Clearance)
C—Pinion
D—Press on Clutch to Take Up Movement
E—8.33 to 9.92 mm (0.328—0.391 in.) Clearance



R32571 –UN–09JAN90

Pinion Clearance

RG,RG34710,2283 –19–15MAR97–2/2

60
20
33

Section 65
John Deere/Denso Starter Motors

Contents

Continued on next page

Page

General Information

IMPORTANT: Never operate starter motor longer than 30 seconds. Allow at least 2 minutes for cooling and battery recovery before operating again. Overheating caused by excessive operation will seriously damage starter motor.

RG,RG34710,2284 –19–15MAR97–1/1

65
05
1

Typical Starting Circuit Operation

When wire from relay (A) is energized, current flows through both pull-in winding (C) and hold-in winding (D) of starter motor to ground.

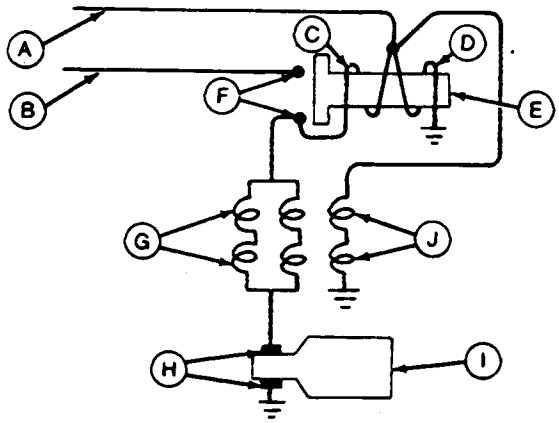
Current through windings engages solenoid plunger (E), which closes main contacts (F). When main contacts close, current through pull-in windings stops. Current continues through hold-in winding, keeping solenoid engaged and main contacts closed.

With main contacts closed, current flows from battery cable (B) to starter motor at a very high rate. Four heavy field windings (G) carry current to commutator brushes (H).

Light shunt windings (J) are wrapped together with two of the heavy field windings. Shunt windings are connected to solenoid switch terminal and directly to ground. They provide additional low speed torque to assist engine rotation and prevent overspeeding of motor.

From field windings, current flows through armature windings (I) to ground, making contact through commutator brushes (H).

Strong magnetic fields are set up by current flow through field windings and armature windings. Windings are arranged so that magnetic fields constantly repel each other, rotating armature.



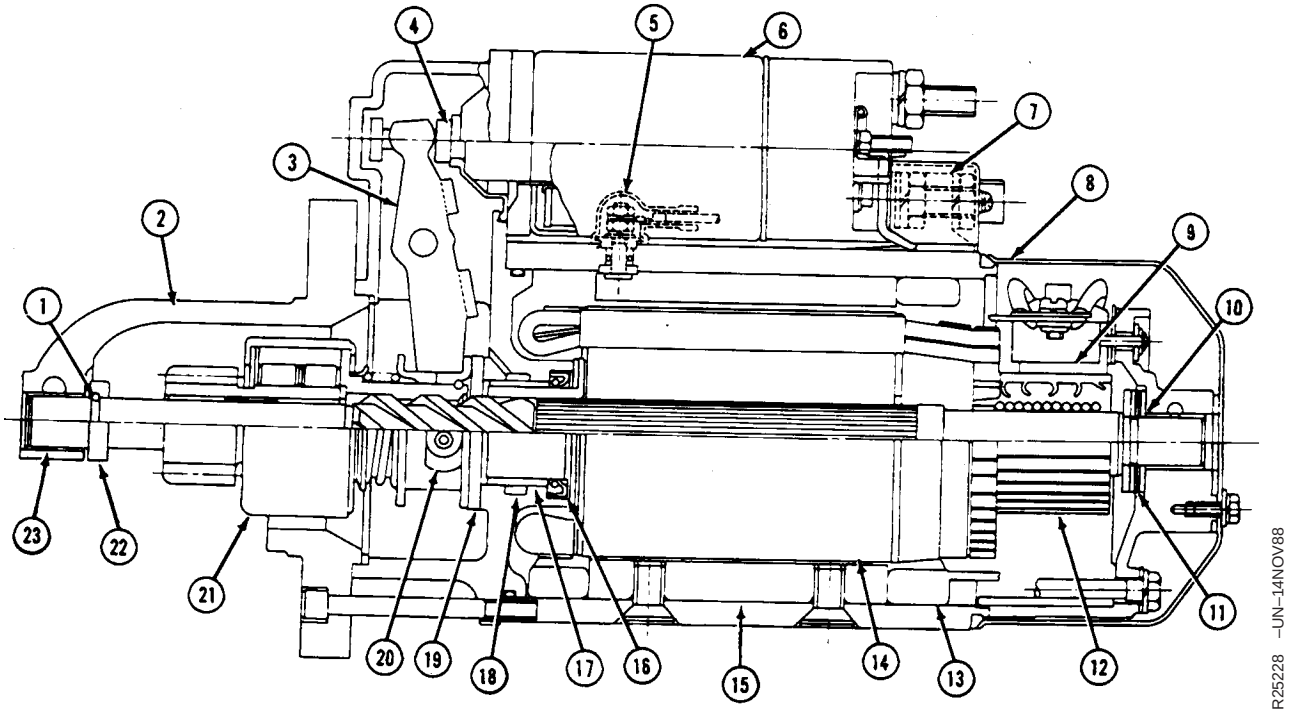
RG1313 –UN–20APR89

Starting Circuit Operation

A—Wire from Relay
B—Cable from Battery
C—Pull-In Winding
D—Hold-In Winding
E—Solenoid Plunger
F—Main Contacts
G—Field Windings
H—Commutator Brushes
I—Armature
J—Shunt Windings

RG,RG34710,2285 –19–15MAR97–1/1

Starter Motor Operation (Conventional Type)



Starter Motor (Conventional Type)

1—Snap Ring
2—Drive End Housing
3—Shift Lever
4—Plunger
5—Shunt Field Terminal
6—Solenoid Assembly
7—Field Connector
8—End Frame Cover
9—Brush
10—Bushing
11—Thrust Washer
12—Commutator
13—Field Windings
14—Armature
15—Pole Shoe
16—Oil Seal
17—Bushing
18—Felt
19—Brake Washer
20—Wear Pads
21—Overrunning Clutch
22—Pinion Stop
23—Bushing

When solenoid (6) engages, it pulls shift lever (3). Shift lever pushes overrunning clutch drive (21) to engage pinion in starter gear on flywheel. As armature (14) turns, it cranks engine.

When engine starts, overrunning clutch spins freely on shaft. This prevents overspeeding of armature by flywheel.

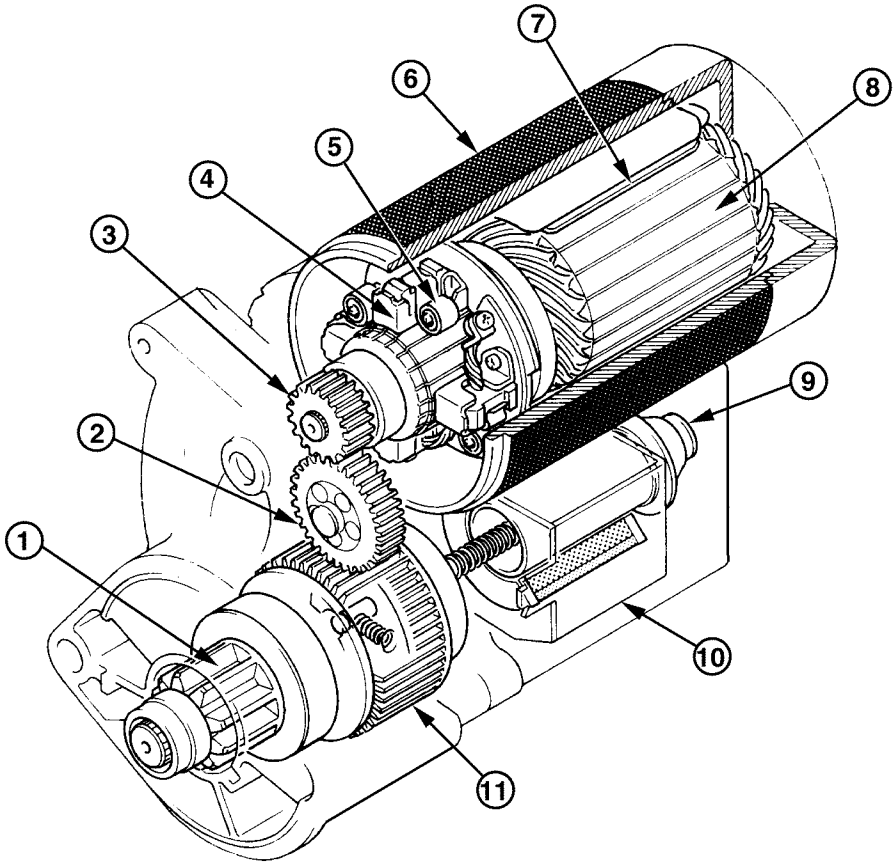
When key switch is released, current to solenoid hold-in winding is shut off. Current can feed through both pull-in and hold-in windings from main contacts, but direction of current is reversed in pull-in winding. The two windings cancel each other, and solenoid is released.

A spring pushes solenoid back to disengaged position. This opens main contacts and shuts off current to field windings and armature.

Shift lever retracts overrunning clutch drive, disengaging pinion from flywheel. Brake washer (19) slows armature to a stop.

RG,RG34710,2286 –19–15MAR97–1/1

Starter Motor Operation (Gear Reduction Type)



RG8614 –UN–03DEC97

Starter Motor (Gear Reduction Type)

1—Pinion Gear
2—Idle (Reducing) Gear
3—Drive Gear
4—Brush
5—Brush Spring
6—Field Frame
7—Field Windings
8—Armature
9—Solenoid Plunger
10—Solenoid Assembly
11—Overrunning Clutch

The reduction or “R” type starter motor is a positive shift type and consists of the motor, reduction gear, overrunning clutch, and solenoid switch. The solenoid switch and overrunning clutch mechanism are on the same axis as shown.

In a conventional starter motor the armature and overrunning pinion rotate at the same speed. In a reduction-type starter motor, the armature rotation is reduced by one-fourth to one-third by the reduction gears, and is transmitted to the pinion through the clutch mechanism.

Operation is as follows:

When solenoid (10) engages, it pushes overrunning clutch drive (11) to engage pinion gear (1) in starter gear on flywheel. As armature (8) turns, it cranks engine.

When engine starts, overrunning clutch (11) spins freely on shaft. This prevents overspeeding of armature by flywheel.

When key switch is released, current to solenoid hold-in winding is shut off. Current can feed through both pull-in and hold-in windings from main contacts, but direction of current is reversed in pull-in winding.

Continued on next page

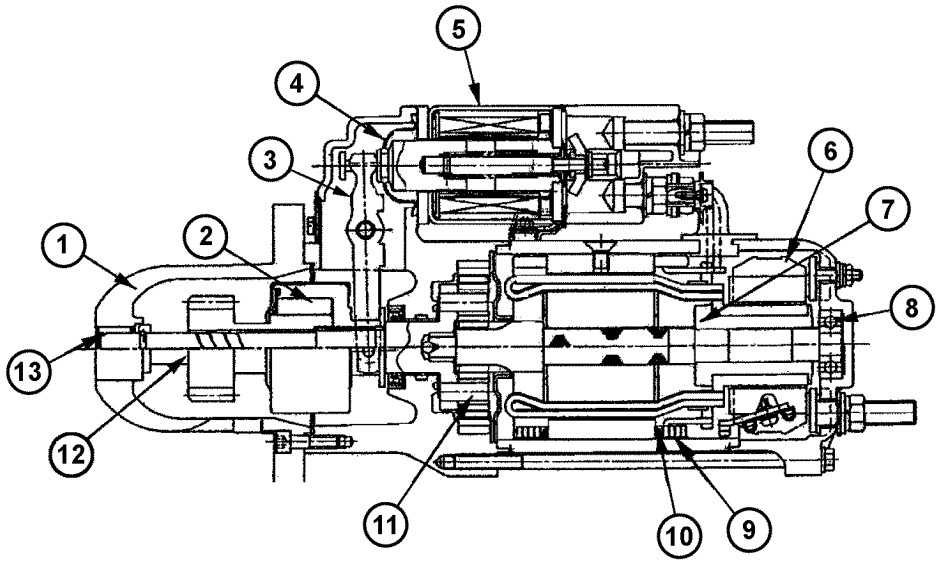
The two windings cancel each other, and solenoid is released.

A spring pushes solenoid back to disengaged position. This opens main contacts and shuts off current to field windings (7) and armature (8).

Overrunning clutch (11) retracts, disengaging pinion gear (1) from flywheel.

RG,RG34710,2287 –19–09OCT00–2/2

Starter Motor Operation (Planetary Type)



Starter Motor (Planetary Type)

1—Drive End Housing
2—Overrunning Clutch
3—Shift Lever
4—Sealing Boot
5—Solenoid
6—Brush
7—Motor
8—Ball Bearing
9—Field Coil
10—Shunt Coil
11—Planetary Reduction Gear
12—Grease Reservoir
13—Needle Bearing

When solenoid (5) engages, it pulls shift lever (3). Shift lever pushes overrunning clutch drive (2) to engage pinion in starter gear on flywheel. As motor (7) turns, it cranks engine through planetary reduction gears (11) which provide a speed reduction, with proportional torque increase, for the pinion gear.

When engine starts, overrunning clutch spins freely on shaft. This prevents overspeeding of armature by flywheel.

When key switch is released, current to solenoid hold-in winding is shut off. Current can feed through both pull-in and hold-in windings from main contacts, but direction of current is reversed in pull-in winding.

The two windings cancel each other, and solenoid is released.

A spring pushes solenoid back to disengaged position. This opens main contacts and shuts off current to field windings and armature.

Shift lever retracts overrunning clutch drive, disengaging pinion from flywheel.

OUOD006,0000064 –19–28AUG02–1/1

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B9B –19–08MAY02–1/3

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUO1004,0000B9B –19–08MAY02–2/3

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000B9B –19–08MAY02–3/3

Service Equipment and Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC). Some tools may be available from a local supplier.

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B9C –19–25SEP00–1/2

65
10
2

Bushing, Bearing, and Seal Driver Set. D01045AA

Remove and install all commutator, drive end, and center bushings and/or bearings.

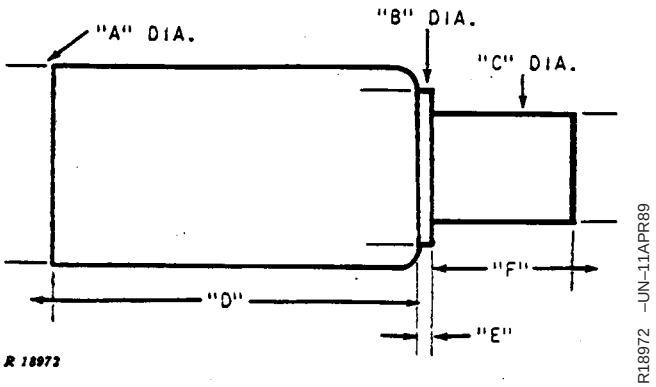
OUO1004,0000B9C –19–25SEP00–2/2

Dealer Fabricated Tools

Starter Motor Commutator, Center Bearing and Drive End Bushing Tool

Commutator and Drive End Bushing Tool		
Dimension	**Removal**	**Installation**
A	25.4 mm (1 in.)	25.4 mm (1 in.)
B	18.6—18.7 mm (0.731—0.736 in.)	18.6—18.7 mm (0.731—0.736 in.)
C	16.8—16.9 mm (0.661—0.665 in.)	16.8—16.9 mm (0.661—0.665 in.)
D	50.8 mm (2 in.)	100.08 mm (3.94 in.)
E	22.9—23.1 mm (0.901—0.909 in.)	0.46—0.56 mm (0.018—0.022 in.)
F	19.9—20.1 mm (0.783—0.791 in.)	19.9—20.1 mm (0.783—0.791 in.)

Center Bearing Bushing Tool		
Dimension	**Removal**	**Installation**
A	39.9 mm (1.57 in.)	39.9 mm (1.57 in.)
B	34.5—34.8 mm (1.36—1.37 in.)	34.5—34.8 mm (1.36—1.37 in.)
C	29.7—30.0 mm (1.17—1.18 in.)	29.7—30.0 mm (1.17—1.18 in.)
D	50.8 mm (2 in.)	50.8 mm (2 in.)
E	24.1—25.9 mm (0.95—1.02 in.)	0.46—0.51 mm (0.018—0.02 in.)
F	22.0—24.0 mm (0.866—0.945 in.)	25.3—25.4 mm (0.996—1.000 in.)



Dealer Fabricated Tools

65
10
3

RG,RG34710,2290 –19–15MAR97–1/1

Other Material

Number	Name	Use
	Mineral Spirits	Clean armature, solenoid and brushes.
	00 Sandpaper	Clean commutator.
	ESSO Beacon 325 or Delco-Remy No. 1960954 Lubricant	Lubricate various stator components.

OUO1004,0000B9D –19–25SEP00–1/1

65
10
4

John Deere/Denso Conventional Starter Motor Repair Specifications

Item	Measurement	Specification
Commutator and Drive End Bushing	ID	17.000—17.028 mm (0.6693—0.6704 in.)
	Wear Limit	17.120 mm (0.674 in.)
	Oil Clearance	0.091—0.178 mm (0.0036—0.0070 in.)
	Wear Limit	0.41 mm (0.016 in.)
	Bushing Depth	0.20—0.56 mm (0.008—0.022 in.)
Center Housing Bushing	ID	30.023—30.074 mm (1.182—1.84 in.)
	Maximum Oil Clearance	0.599 mm (0.0236 in.)
	Bushing Depth	0.43—0.81 mm (0.017—0.032 in.)
Standard Commutator	Runout	0.05 mm (0.002 in.)
	Wear Limit	0.38 mm (0.016 in.)
Armature	Undercut Depth	0.79 mm (0.0312 in.)
	Wear Limit	0.20 mm (0.008 in.)
Commutator	OD	48 mm (1.89 in.)
	Minimum OD	46 mm (1.81 in.)
Armature	End Play	0.05—0.50 mm (0.002—0.020 in.)
Pole Shoe Cap Screws	Torque	41 N•m (30 lb-ft)
New Brush	Length	26 mm (1.02 in.)
Used Brush	Minimum Length	16 mm (0.68 in.)
Brush Spring	Minimum Tension	11 N (40 ounce-force)
Shift Lever Pivot Cap Screw	Torque	41 N•m (30 lb-ft)
Center Housing-to-Field Frame Cap Screw	Torque	8 N•m (71 lb-in.)
Armature End Play	Torque	0.05—0.50 mm (0.002—0.020 in.)
Drive End Housing-to-Center Housing Cap Screws	Torque	14 N•m (124 lb-in.)
Commutator End Frame Cap Screws	Torque	14 N•m (124 lb-in.)

OUO1004,0000BB0 –19–26SEP00–1/1

John Deere/Denso Conventional Starter Motor Test Specifications

John Deere Starter Motor Part No.	Denso Starter Motor Part No.	System Voltage	Rating Type	kW	Motor Voltage	No Load Test Current Draw Amps (Max.)	RPM (Min.)
AR41627	028000-3290	12	F	4.0	11.7	130	3100
AR46886	028000-3811	12	F	5.0	11.7	130	3100
AR55639	028000-3290	12	F	4.0	11.7	130	3100
AR62154	028000-3810, 028000-3811	12	F	5.0	11.7	130	3100
AR63341	028000-3970	12	F	4.0	11.7	130	3100
AR63341	028000-3971	12	F	4.0	11.7	130	3100
AR77254	028000-3291	12	F	4.0	11.7	130	3100
AR77254	028000-3291	12	F	4.0	11.7	130	3100
AR84333	028000-5250	24	F	7.5	23.5	75	4200
CH12084	028000-7640	12	R	1.0	11.5	90	3000
CH12096	028000-5660	12	R	2.5	11.0	180	3500
CH15586	028000-7640	12	R	1.0	11.5	90	3000
CH19282	128000-0740	12	R	1.0	11.5	90	3000
CH19284	128000-0710	12	R	1.4	11.5	90	3500
CH19285	128000-0790	12	R	2.5	11.0	180	3500
RE13722	028000-3292	12	F	4.0	11.7	130	3100
RE15663	028000-5251	24	F	7.5	23.5	75	4200
RE15718	128000-0480	24	F	7.5	23.5	75	4800
RE23900	128000-3690	12	F	4.0	11.7	130	3100
RE38336	128000-5970, 128000-5971	12	IIF	4.0	11.7	130	3300
RE38369	128000-7170	24	IIF	7.5	23.5	80	3500
RE39832	128000-7230	12	IIF	4.0	11.7	130	3300
RE39833	128000-7240	24	IIF	7.5	23.5	80	3500
RE40595	128000-8303	24	R	4.5	23.0	90	3500
RE41799	028000-8400	12	R	2.5	11.0	180	3500
RE42670	128000-7250	12	IIF	4.0	11.7	130	3300
RE43266	128000-5972, 228000-2360	12	IIF	4.0	11.7	130	3300
RE43421	128000-7230	12	IIF	4.0	11.7	130	3300
RE43422	128000-0480	24	F	7.5	23.5	75	4800
RE44151	128000-7172	24	IIF	7.5	23.5	80	3500
RE44511	228000-2390	24	IIF	7.5	23.5	80	3500
RE44515	128000-7172	24	IIF	7.5	23.5	80	3500
RE45328	128000-7172, 228000-2390	24	IIF	7.5	23.5	80	3500
RE48827	128000-8301	24	R	4.5	23.0	90	3500
RE500199	228000-7011	24	R	7.8	23	120	3800
RE500345	228000-6570, 22800-7011A	24	R	7.5	23	120	3800

Continued on next page

John Deere Starter Motor Part No.	Denso Starter Motor Part No.	System Voltage	Rating Type	kW	Motor Voltage	No Load Test Current Draw Amps (Max.)	RPM (Min.)
RE501060	228000-7411	24	R	7.8	23	120	3800
RE501150	228000-7410	24	R	7.8	23	120	3800
RE501294	228000-7871	12	R	4.8	11	220	4200
RE502811	228000-8470	12	R	4.8	11	220	4200
RE504244	228000-9140	12	R	4.8	11	220	4200
RE504245	228000-9150	24	R	7.8	23	120	3800
RE505465	228000-9630	24	R	7.8	23	120	3800
RE506825	42800-0120	12	R	4.8	11.5	200	2000
RE506826	42800-0130	24	R	7.8	23.5	120	2000
RE522851	42800-121	12	R	4.8	11.5	200	2000
RE522852	42800-131	24	R	7.8	23.5	120	2000
RE54416	128000-5973, 228000-2360	12	IIF	4.0	11.7	130	3300
RE54874	228000-2370	12	IIF	4.0	11.7	130	3300
RE54909	228002-2380	12	IIF	4.0	11.7	130	3300
RE55378	228000-2370	12	IIF	4.0	11.7	130	3300
RE55641	228000-2390	24	IIF	7.5	23.5	80	3500
RE57078	228000-2390	24	IIF	7.5	23.5	80	3500
RE59583	228000-4690	12	IIF	4.0	11.7	130	3300
RE59584	228000-4730	24	IIF	7.5	23.5	80	3500
RE59585	228000-4611	24	IIF	7.5	23.5	80	3500
RE59596	228000-4700	12	IIF	4.0	11.7	130	3300
RE59589	228000-4601	12	IIF	4.0	11.7	130	3300
RE61517	228000-4610	24	IIF	7.5	23.5	80	3500
RE65100	228000-4630	12	IIF	4.0	11.7	130	3300
RE65173	228000-4730	24	IIF	7.5	23.5	80	3500
RE65174	228000-4611	24	IIF	7.5	23.5	80	3500
RE65176	228000-4601	12	IIF	4.0	11.7	130	3300
RE65191	228000-4700	12	IIF	4.0	11.7	130	3300
RE70958	228000-6560	24	R	7.8	23	120	3800
RE70961	228000-7010	24	R	7.8	23	120	3800
RE79474	228000-6550	12	R	4.8	11	220	4200

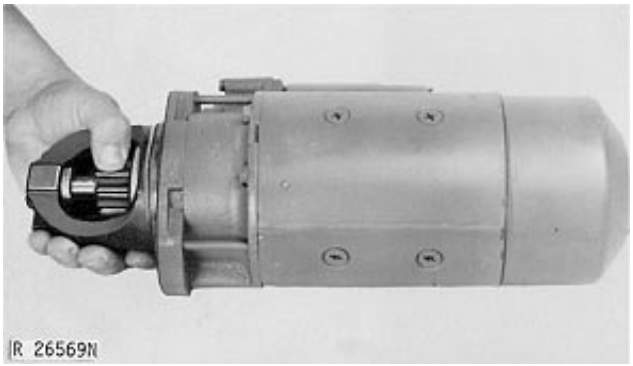
NOTE: Earlier Denso starter motors may have the original Nippondenso label.

RG,RG34710,2292 –19–07JUL05–2/2

Test Starter Motor Before Disassembly

IMPORTANT: Never operate starter motor more than 30 seconds. Allow at least 2 minutes for cooling and battery recovery before operating again. Overheating, caused by excessive operation, will seriously damage starter motor.

1. Turn overrunning clutch drive by hand. Clutch drive should turn freely on shaft in overrunning direction only.



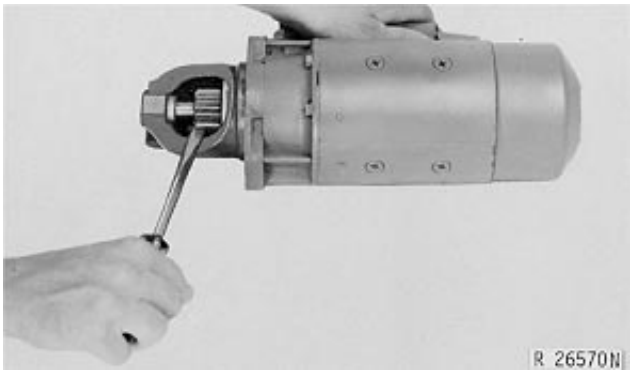
Turn Overrunning Clutch Drive

RG,RG34710,2294 –19–15MAR97–1/2

2. Turn armature by prying against pinion with screwdriver. Check for dragging armature, seized bushings, or bent shaft.

   If you discover any interference, disassemble and repair starter motor.

IMPORTANT: Do not conduct the no-load test unless armature turns freely. Damage to the starter motor may result.



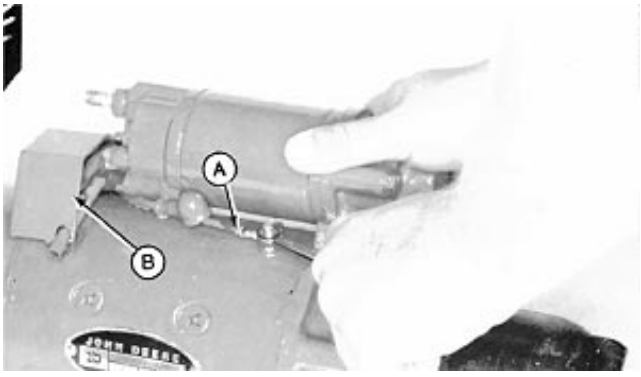
Turn Armature

RG,RG34710,2294 –19–15MAR97–2/2

Make Solenoid Pull-In Test

1. To prevent damage, solenoid must be on starter motor when testing the windings.
2. Remove shunt field winding lead (A) from terminal on field frame.
3. Remove terminal cover (B).

A—Shunt Field Winding Lead
B—Terminal Cover



Shunt Field Winding Lead and Cover

Continued on next page

RG,RG34710,2295 –19–15MAR97–1/4

4. Remove field coil connector (A).

A—Field Coil Connector

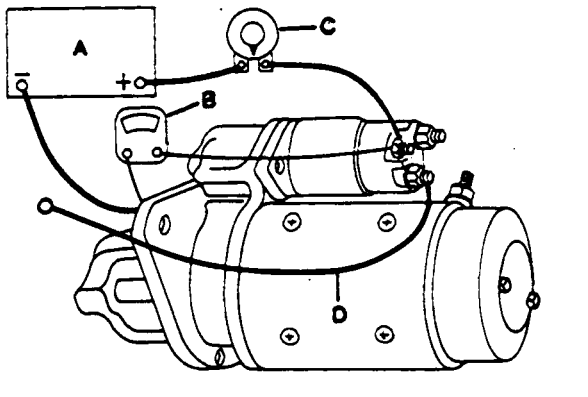
Remove Field Coil Connector

RG,RG34710,2295 –19–15MAR97–2/4

5. Make connections as shown.

With 8 volts applied, the solenoid should push the pinion out to the pinion stop when the jumper wire (D) is connected. The drive gear should remain out at the pinion stop. Current through jumper wire will be approximately 90 amps. Use a heavy jumper wire and remove as soon as the pinion is at stop.

A—12-Volt Battery
B—Voltmeter
C—Carbon Pile Resistor
D—Jumper Wire



Make Connections

RG,RG34710,2295 –19–15MAR97–3/4

If solenoid does not engage, remove solenoid and manually move shift lever (A) back and forth. If lever moves smoothly, pull-in winding is defective and solenoid must be replaced. If not, disassemble and repair starter.

If solenoid engages but then chatters instead of staying firmly engaged, the hold-in winding is defective and solenoid must be replaced. Be sure solenoid ground wire is connected to starter frame.

A—Shift Lever

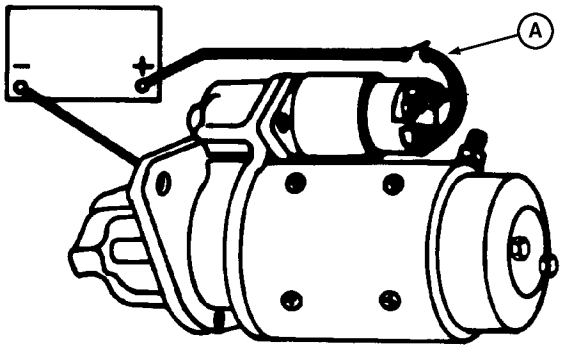
Move Shift Lever

RG,RG34710,2295 –19–15MAR97–4/4

Make Solenoid Return Test

1. Make connections as shown.
2. Close the switch (A).
3. Pull the drive out until the pinion contacts the pinion stop. When released, the drive should return without hesitation.

A—Switch



RG3896 –UN–05DEC97

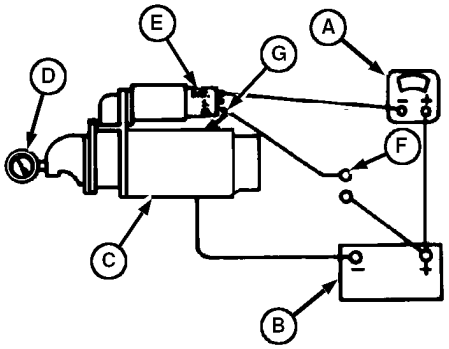
Make Solenoid Return Test

RG,RG34710,2296 –19–15MAR97–1/1

65
10
10

Make No-Load Test

1. Make connections as shown, and use an ammeter (A) capable of measuring several hundred amps.
2. Measure current draw and compare with specifications given earlier in this group.
3. If speed and current draw are slightly low, connect a voltmeter between motor terminal and frame. Observe voltage during test. Voltage may be reduced because of high current draw on battery.
4. If speed or current draw is significantly different than specified, diagnose problem as follows:



RG11163 –UN–28SEP00

Make Connections

A—Ammeter
B—Battery
C—Starter Frame
D—Tachometer
E—Battery Terminal
F—Switch
G—Field Coil Connector

RG,RG34710,2297 –19–15MAR97–1/1

Diagnose No-Load Test

Fails to Operate-Low Current Draw (Approx. 25 Amps)

Open series field circuit.

Open armature coils.

Defective brush contact with commutator.

Fails to Operate-High Current Draw

Grounded terminal or fields.

Seized bearings.

Low Speed-Low Current Draw

High internal resistance

Defective brush contact with commutator

Low Speed-High Current Draw

Excessive friction

Shorted armature

Grounded armature or fields.

High Speed-Low Current Draw

Open shunt field circuit.

High Speed-High Current Draw

Shorted series field coils.

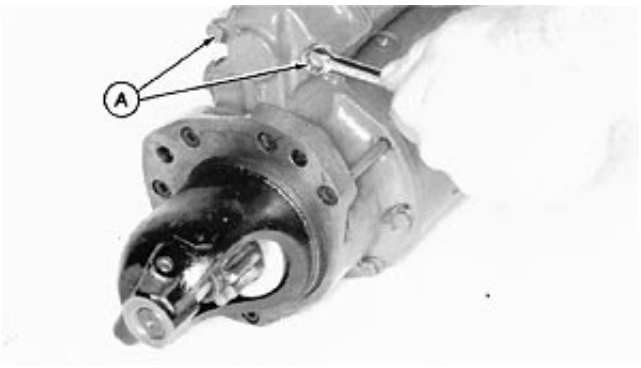
RG,RG34710,2298 –19–15MAR97–1/1

Disassemble Starter Motor

NOTE: Starter motor has metric bolts and nuts except for those on switch cover.

1. Remove solenoid cap screws (A) and lock washers.

IMPORTANT: Whenever starter motor is disassembled, for any reason, lubricate as follows: Apply a coat of ESSO Beacon 325 or Delco-Remy Lubricant No. 1960954 to both end bearings. Grease reservoirs for both end bearings, armature shaft except center bearing area, brake washer, solenoid plunger, both ends of shift lever, wear pads, and shift lever pivot shaft.



Solenoid Cap Screws

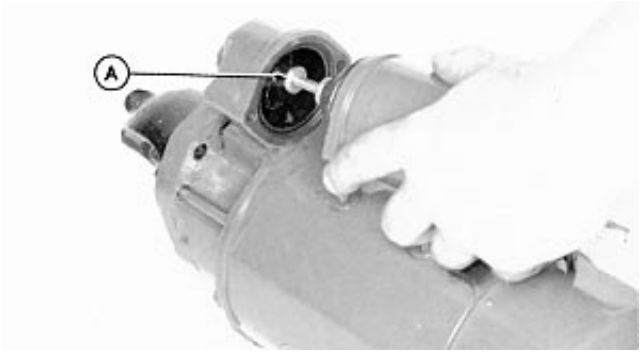
A—Solenoid Cap Screws

Continued on next page

RG,RG34710,2299 –19–06MAY02–1/10

2. Remove solenoid from center bearing housing by lifting plunger shaft (A) up and away from shift lever.

A—Plunger Shaft

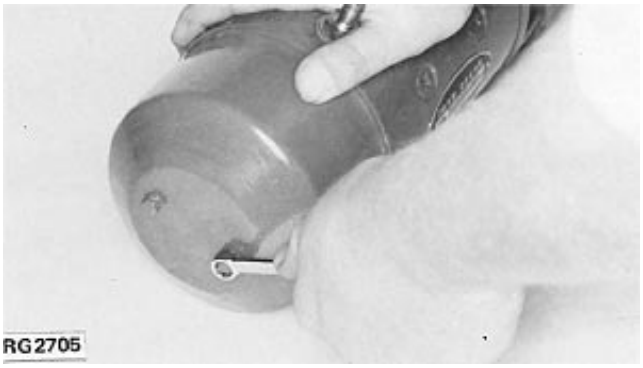


Lift Plunger Shaft

RG,RG34710,2299 –19–06MAY02–2/10

65
10
12

3. Remove end frame cover and gasket.



Remove End Frame Cover and Gasket

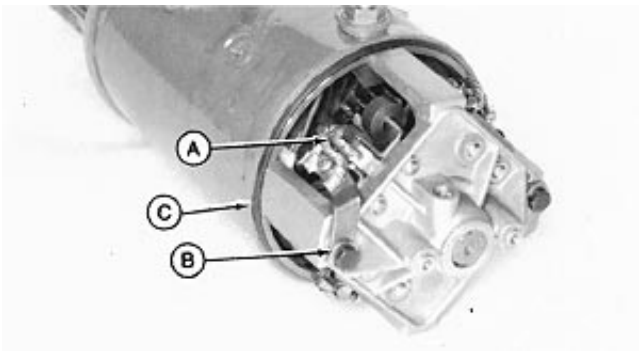
RG,RG34710,2299 –19–06MAY02–3/10

4. Inspect brush leads (A) for fraying or corrosion.

NOTE: If only new brushes are going to be installed, it isn't necessary to remove the commutator end frame.

5. Remove commutator end frame cap screws (B) with washers. Inspect O-ring (C) for wear.

A—Brush Leads
B—Commutator End Frame Cap Screws
C—O-Ring



Inspect Brush Leads and O-Ring

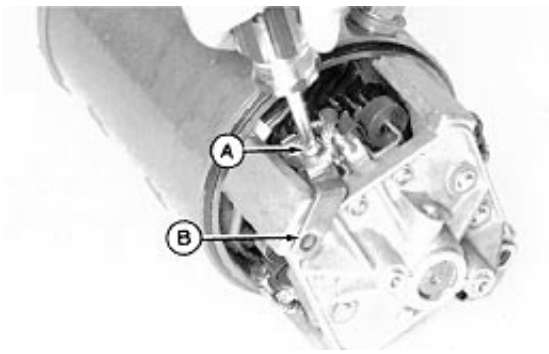
Continued on next page

RG,RG34710,2299 –19–06MAY02–4/10

6. Remove brush lead cap screws (A).

7. Remove brush ground straps (B).

A—Brush Lead Cap Screws
B—Brush Ground Straps



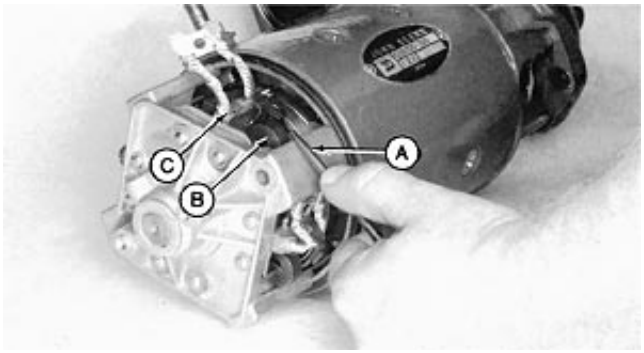
RG3901 –UN–09NOV89

Remove Cap Screws and Ground Straps

RG,RG34710,2299 –19–06MAY02–5/10

8. Use an O-ring pick (A) or other suitable tool to pull brush spring (B) back and remove brush (C).

A—O-Ring Pick
B—Brush Spring
C—Brush



RG3902 –UN–09NOV89

Remove Brush

RG,RG34710,2299 –19–06MAY02–6/10

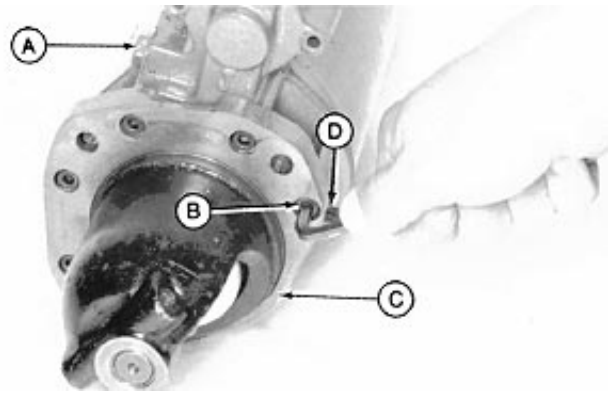
9. Remove shift lever pivot (A).

NOTE: Before removal of drive end housing, place alignment marks on drive end housing and center bearing housing for aid in reassembly.

10. Remove drive end housing Allen screws (B) and center bearing housing cap screws (D).

11. Remove drive end housing (C).

A—Shift Lever Pivot
B—Allen Screw (6 used)
C—Drive End Housing
D—Cap Screw (2 Used)



RG3903 –UN–09NOV89

Remove Drive End Housing

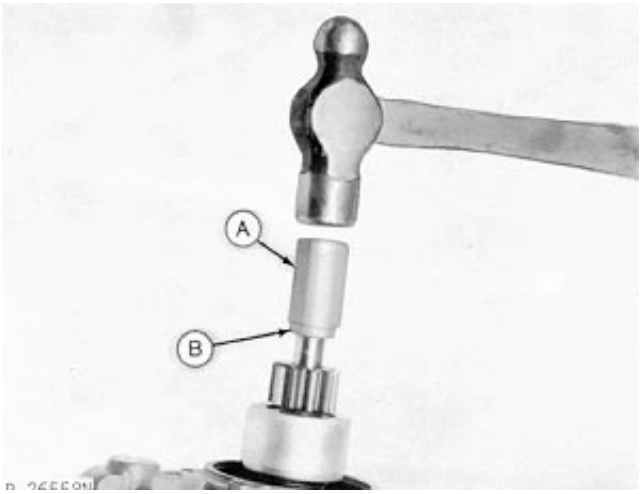
Continued on next page

RG,RG34710,2299 –19–06MAY02–7/10

12. Use a pipe coupling (A) or other metal cylinder to drive pinion stop (B) toward pinion.

13. Remove retaining ring and slide pinion stop off shaft.

A—Pipe Coupling
B—Pinion Stop



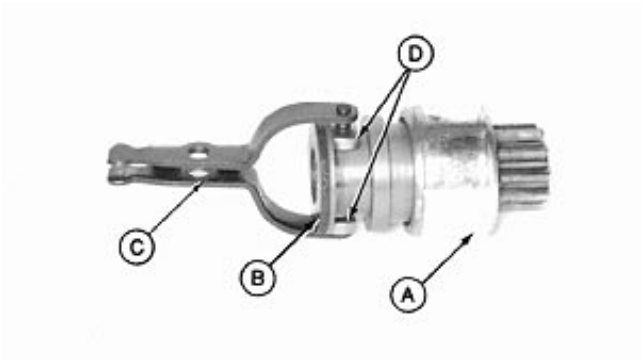
Slide Pinion Stop

RG,RG34710,2299 –19–06MAY02–8/10

65
10
14

14. Carefully remove overrunning clutch (A), brake washer (B), shift lever (C), and wear pads (D) from center bearing housing and armature shaft. Inspect wear pads for excessive wear or damage. Replace wear pads if necessary.

A—Overrunning Clutch
B—Brake Washer
C—Shift Lever
D—Wear Pads



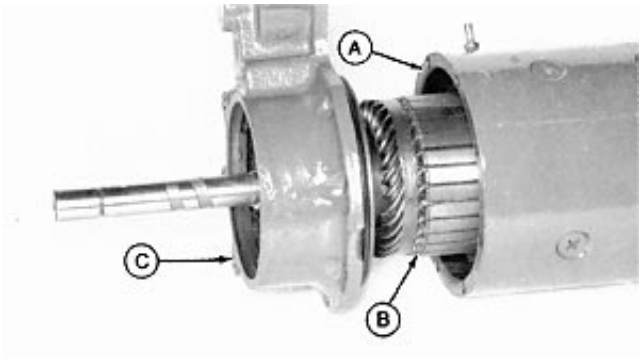
Inspect for Damage

RG,RG34710,2299 –19–06MAY02–9/10

15. Remove center bearing housing (C).

16. Carefully remove armature (B) from field frame (A).

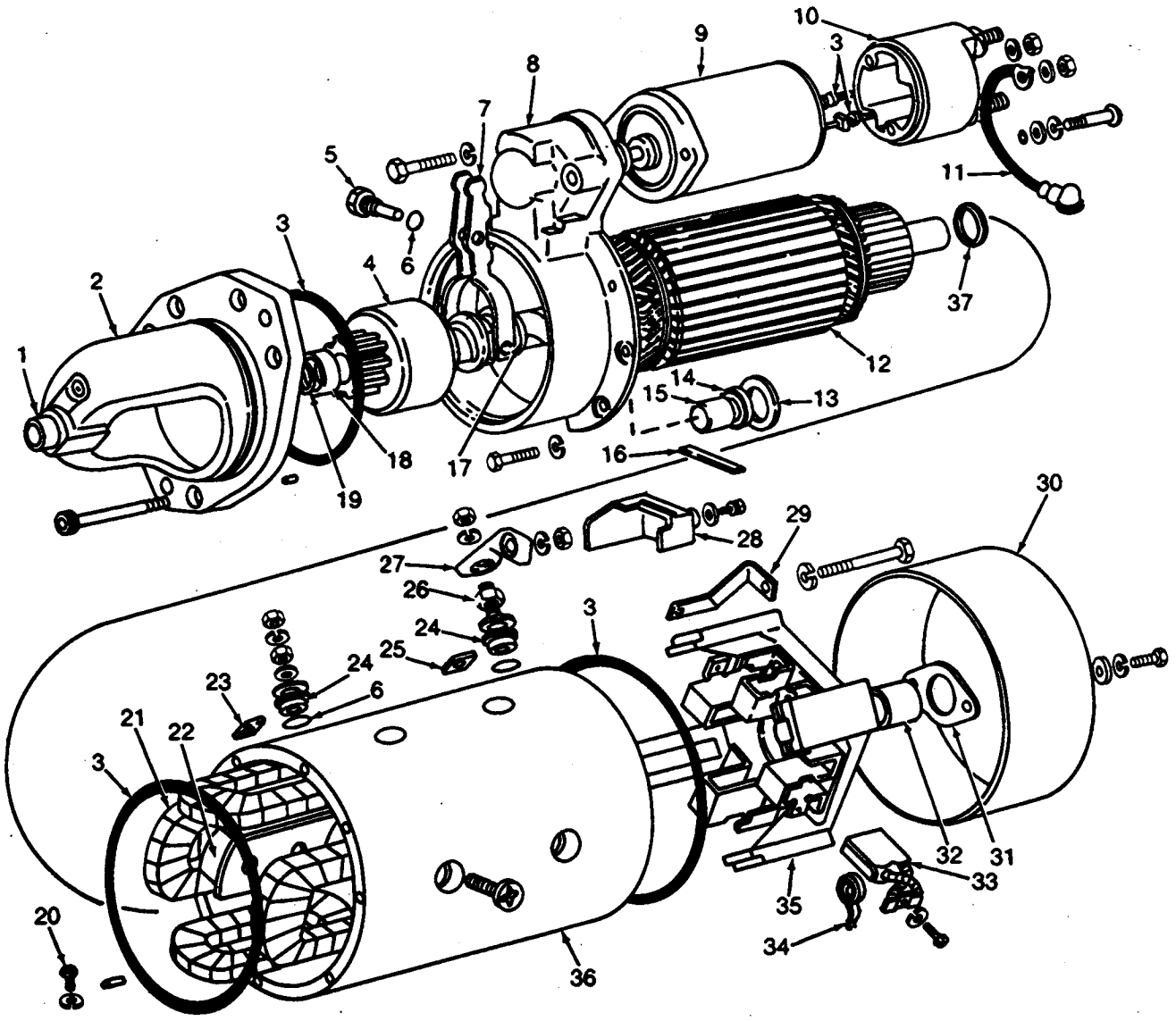
A—Field Frame
B—Armature
C—Center Bearing Housing



Remove Armature

RG,RG34710,2299 –19–06MAY02–10/10

John Deere/Denso Conventional Starter Motor Exploded View



Starter Motor Components

1—Drive End Bushing
2—Drive End Housing
3—O-Ring
4—Overrunning Clutch
5—Shift Lever Pivot
6—O-Ring
7—Shift Lever
8—Center Bearing Housing
9—Solenoid Winding
10—Solenoid Switch Cover
11—Shunt Winding Lead
12—Armature
13—Bakelite Washer
14—Oil Seal
15—Center Bearing Bushing
16—Oil Felt
17—Brake Washer
18—Pinion Stop
19—Snap Ring
20—Shunt Winding Ground Screw
21—Field Winding
22—Pole Shoe (4 Used)
23—Square Washer
24—Insulating Bushing
25—Square Insulator
26—Special Bolt
27—Field Coil Connector
28—Terminal Cover
29—Brush Ground Strap
30—End Frame Cover
31—Gasket
32—Commutator End Frame Bushing
33—Brush (4 Used)
34—Brush Spring (4 Used)
35—Commutator End Frame Bushing
36—Field Frame
37—Shims (as required)

OUO1004,0000B48 –19–15SEP00–1/1

Install New Bushings/Needle Bearings

NOTE: Refer to exploded view on previous page.

1. If needed, install new bushings (1, 15, and 32).
2. Install a new oil seal (14) and oil felt (16) saturated with clean engine oil.
3. Make a bushing tool as shown earlier in Dealer Fabricated Tools or use the following components from the D01045AA Bushing, Bearing, and Seal Driver Set.

Commutator and Drive End Bushing Tools		
Component	**Bushing Removal**	**Bushing Installation**
Handle	27487	27487
Disk (Spacers)	27491	27492
Disk (Pilot)	27493	27493
Disk	27494	27495

4. Install commutator and drive end bushing and determine depth. Compare to specification below.
5. Ream bushing, if necessary, so following specifications are maintained.

Specification

Commutator and Drive End
Bushing—ID ..... 17.000—17.028 mm (0.6693—0.6704 in.)
Wear Limit ..... 17.120 mm (0.674 in.)
Oil Clearance ..... 0.091—0.178 mm (0.0036—0.0070 in.)
Wear Limit ..... 0.41 mm (0.016 in.)
Bushing Depth ..... 0.20—0.56 mm (0.008—0.022 in.)

6. Install center bushing and oil seal using tools and specifications listed below.

Center Bushing Tools		
Component	**Bushing**	**Oil Seal**
Handle	27487	27487
Disk	27505	27512
Disk (pilot)	27501	27501

Specification

Center Housing Bushing—ID ..... 30.023—30.074 mm (1.182—1.84 in.)
Maximum Oil Clearance ..... 0.599 mm (0.0236 in.)
Bushing Depth ..... 0.43—0.81 mm (0.017—0.032 in.)

RG,RG34710,2300 –19–09OCT00–1/1

Clean Starter Motor Components

IMPORTANT: Do not immerse the solenoid, field windings, or armature in cleaning solvent because it may damage the insulation.

1. Clean parts by wiping with a cloth or brush, moistened with mineral spirits.
2. Dry with compressed air.
3. Clean the drive end housing, overrunning clutch, center bearing housing, and commutator end frame the same way.

   All other parts which are not made of rubber or mentioned previously, can be dipped in cleaning solvent to remove all oil and dirt.

RG,RG34710,2301 –19–15MAR97–1/1

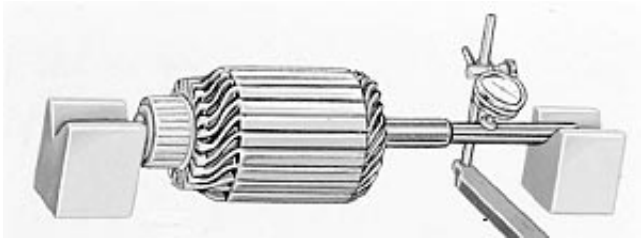
Inspect Armature

1. Place armature in V-blocks and check for bent shaft. If shaft is bent, replace armature.

   Inspect armature using the following specifications:

Specification	
Standard Commutator—Runout	0.05 mm (0.002 in.)
Wear Limit	0.38 mm (0.016 in.)
Armature—Undercut Depth	0.79 mm (0.0312 in.)
Wear Limit	0.20 mm (0.008 in.)
Commutator—OD	48 mm (1.89 in.)
Minimum OD	46 mm (1.81 in.)
Armature—End Play	0.05—0.50 mm (0.002—0.020 in.)

2. Check armature for opens, shorts and grounds. Burned edge of commutator bar indicates an open circuit.



Inspect Armature

RG,RG34710,2302 –19–15MAR97–1/1

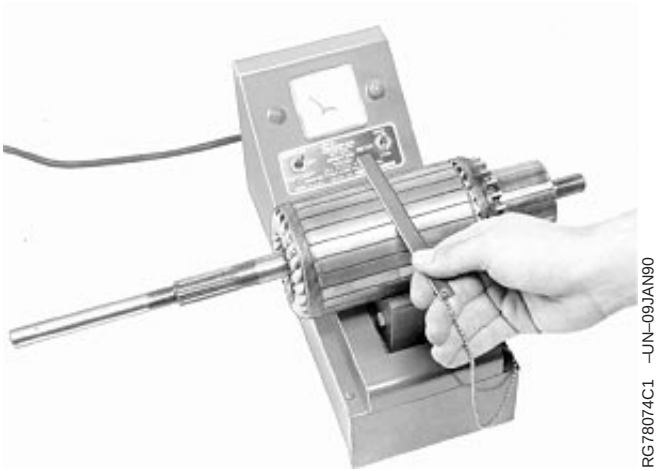
65
10
17

Make Short Circuit Test

1. Place armature in a growler and hold hacksaw blade above each slot while slowly rotating the armature.

2. If coil is shorted, the blade will be attracted to and repelled from the slot.

   A short circuit most often occurs because of copper dust or filings between two commutator segments. Clean commutator segments to correct this short.



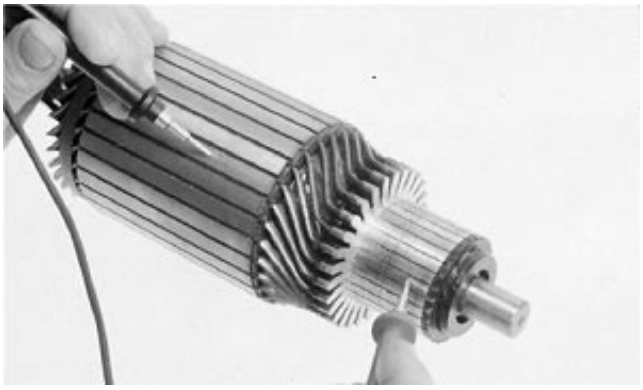
Place Armature in Growler

DPSG,OUOE003,29 –19–18DEC98–1/1

Make Armature Ground Test

1. Set ohmmeter to read on highest scale.
2. Place one test lead on the armature core or shaft. Place other lead on commutator.

   If the test meter indicator swings toward zero, the armature is grounded. Replace armature.



Make Armature Ground Test

65
10
18

RG,RG34710,2303 –19–15MAR97–1/1

Make Open Circuit Test

1. Set ohmmeter to read on lowest scale.
2. Place one test lead on ohmmeter segment. Place other test lead on an adjacent segment.
3. Repeat this operation for all segments by moving one lead at a time.

   If the test meter indicator does not swing to zero and remains stationary, the armature coil between these two segment is open. Replace armature.

Make Open Circuit Test

RG,RG34710,2304 –19–15MAR97–1/1

Repair Armature

1. If commutator bars are rough or burned, clean with 00 sandpaper. Never use emery cloth.

2. Clean all dust from armature.

IMPORTANT: Do not clean armature with solvent. Solvent could damage insulation on windings. Use only mineral spirits and a clean cloth or brush. Wipe dry with a clean cloth.

RG,RG34710,2305 –19–15MAR97–1/1

Inspect Overrunning Clutch and Pinion

1. Rotate the pinion. Pinion gear should rotate smoothly (but not easily) in one direction. The pinion gear should not rotate in the opposite direction.

If pinion gear does not rotate smoothly or if it is worn, chipped, or burred, it should be replaced.

RG,RG34710,2306 –19–15MAR97–1/1

Make Grounded Circuit Test for Field Windings

1. Remove screw and hang eyelet terminal in the air.
2. Set ohmmeter to read on highest scale.
3. Place one test lead on a clean spot on the field frame. Place other leads on the copper terminal bolt as shown.

   If the ohmmeter indicator swings toward zero, a grounded circuit is indicated. Replace the field windings.

Make Grounded Circuit Test

RG,RG34710,2307 –19–15MAR97–1/1

Make Open Circuit Test for Shunt Windings

1. Set the ohmmeter on its lowest scale.
2. Place one test lead on the eyelet terminal. Place other lead on the terminal bolt.

   If the ohmmeter does not swing to zero, it is open circuited. Replace the field winding assembly.

Make Open Circuit Test for Shunt Windings

RG,RG34710,2308 –19–15MAR97–1/1

Make Open Circuit Test for Field Windings

1. Set ohmmeter on its lowest scale.
2. Place one test lead on the naked field end. Place other lead on the copper terminal bolt.

   If ohmmeter dial indicator does not swing to zero, the field windings are open circuited. Replace field windings.

T31429NY –UN–27JUL89

Make Open Circuit Test for Field Windings

65
10
21

RG,RG34710,2309 –19–15MAR97–1/1

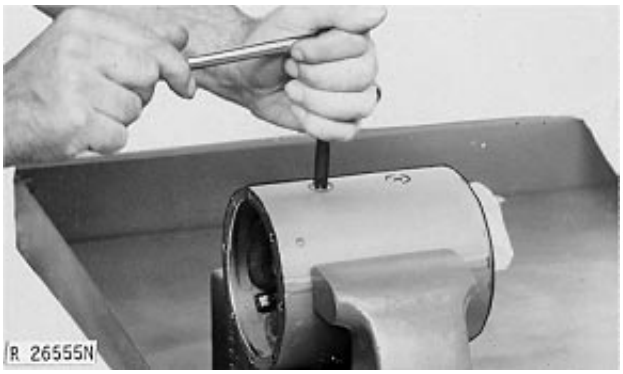
Remove Field Windings (If Necessary)

1. Use a large screwdriver bit and socket wrench on pole shoe cap screws.
2. Scribe mark on pole shoe and field frame for proper assembly.

IMPORTANT: Do not tightly squeeze side of main frame in a vise or strike with a hammer. Damage may result.

If an impact screwdriver is used to loosen screws, support each pole shoe individually using a pole shoe spreader or the nose of an anvil.

Remove windings very carefully. Windings are easily damaged, causing shorts, opens, or grounds.



R26555N –UN–09FEB90

Remove Field Windings

RG,RG34710,2310 –19–15MAR97–1/1

Install Field Windings

NOTE: Two different field winding assemblies are available. Starter motors with date code 9U0001 and lower have shunt wire lead (A), while those with date code 10U001 and higher have shunt wire lead (B). Shunt wire lead (A) will be too short for the later starter motors.

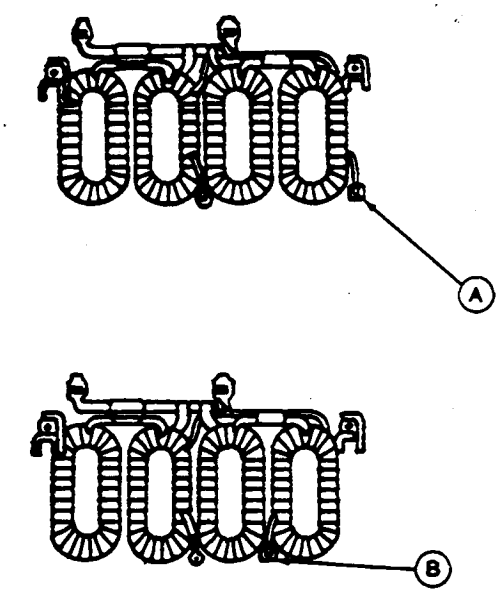
1. Carefully insert field windings.
2. Align scribe marks on pole shoes and field frame.
3. Tighten pole shoe screws to specifications.

65
10
22

Specification

Pole Shoe Cap Screws—Torque ..... 41 N•m (30 lb-ft)

A—Earlier Field Winding Shunt Lead
B—Later Field Winding Shunt Lead



RG4958 –UN–06APR89

Install Field Windings

RG,RG34710,2311 –19–15MAR97–1/1

Inspect and Repair Brushes

Replace brushes if they are oil soaked, worn, damaged, or worn beyond specification.

Specification

New Brush—Length ..... 26 mm (1.02 in.)
Used Brush—Minimum Length ..... 16 mm (0.68 in.)

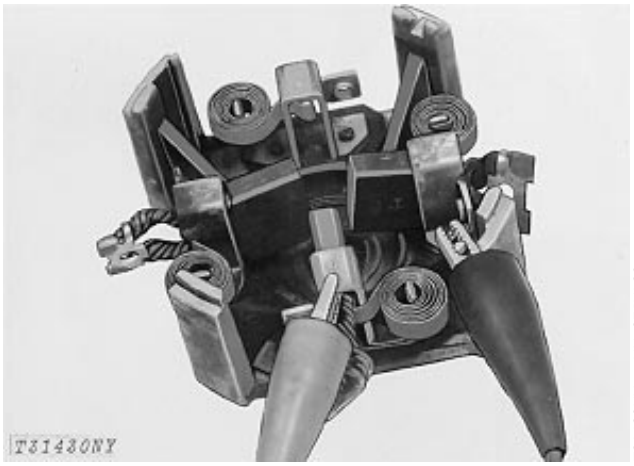
If brushes are burned or rough, use 00 sandpaper to clean commutator contact area of brushes. Never use emery cloth. Clean all dust from brush before reassembly.

RG,RG34710,2312 –19–15MAR97–1/1

Test Brush Holder for Grounds

1. Set ohmmeter on its highest scale.
2. Place one test lead on commutator end frame. Place other lead on brush holder.

   If needle swings toward zero, the positive brush holder is grounded and should be replaced.



Test Brush Holder for Grounds

RG,RG34710,2313 –19–15MAR97–1/1

Measure Brush Spring Tension

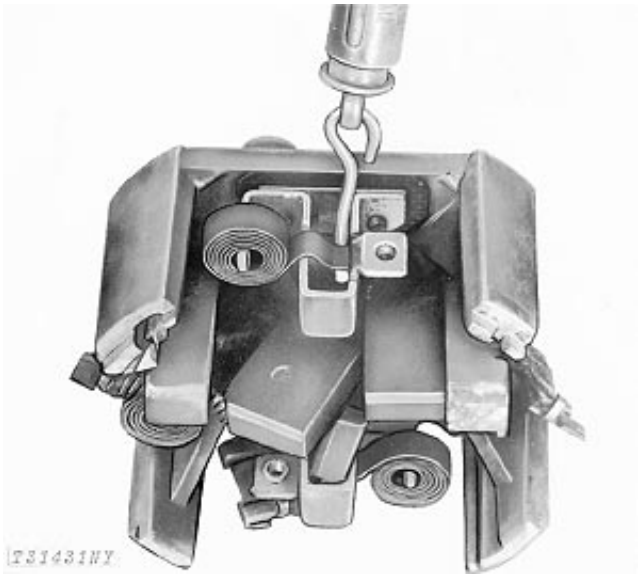
Measure spring tension with a spring scale.

Brush spring tension should be as specified, just as the spring leaves the brush holder.

Specification

Brush Spring—Minimum Tension..... 11 N (40 ounce-force)

When measuring tension, scale should be parallel with edge of brush holder.



Measure Brush Spring Tension

RG,RG34710,2314 –19–15MAR97–1/1

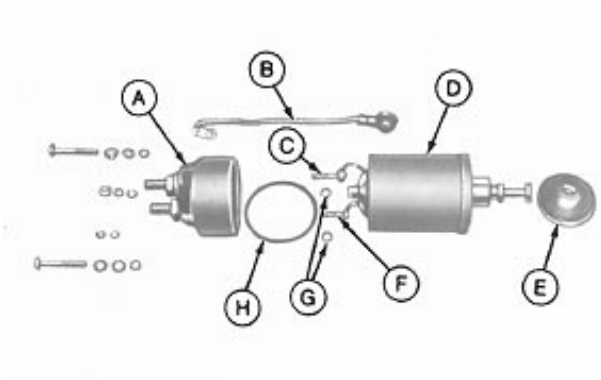
Disassemble Solenoid

1. Remove nut, washer and gasket from solenoid “S” terminal (C).
2. Remove nut, washer and gasket from pull-in terminal (F).
3. Remove switch cover (A).
4. Inspect all solenoid parts for wear, dirt, and corrosion.
5. Wipe all parts and connections with mineral spirits and a clean cloth or brush. Dry with a clean cloth.

   Firm pressure should be felt on the plunger when fully depressed. If plunger is weak, replace solenoid winding and plunger assembly.
6. Place gaskets on pull-in terminal and “S” terminal.
7. Align main contact vertically.
8. Place packing on switch cover.
9. Tighten switch cover screws to solenoid winding and plunger assembly securely.

IMPORTANT: Solenoid contacts and plunger will be damaged if current is applied to solenoid when removed from starter motor.

65
10
24



RG3906 –UN–09NOV89

Disassemble Solenoid

A—Switch Cover
B—Shunt Winding Lead
C—“S” Terminal
D—Solenoid Winding and Plunger Assembly
E—Plunger Cover
F—Pull-In Winding Terminal
G—Gaskets
H—Packing

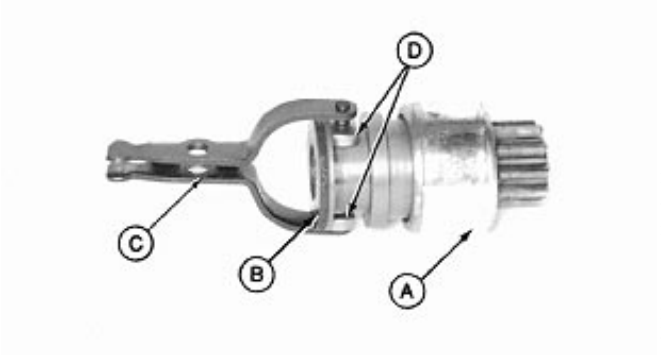
RG,RG34710,2315 –19–15MAR97–1/1

Assemble Starter Motor

1. Lubricate both ends of shift lever (C) and wear pads (D) on overrunning clutch (A), with a multi-purpose lubricant.
2. Lubricate brake washer (B) and place on end of overrunning clutch.

NOTE: Avoid excessive lubrication.

A—Overrunning Clutch
B—Brake Washer
C—Shift Lever
D—Wear Pads



RG3904 –UN–09NOV89

Assemble Starter Motor

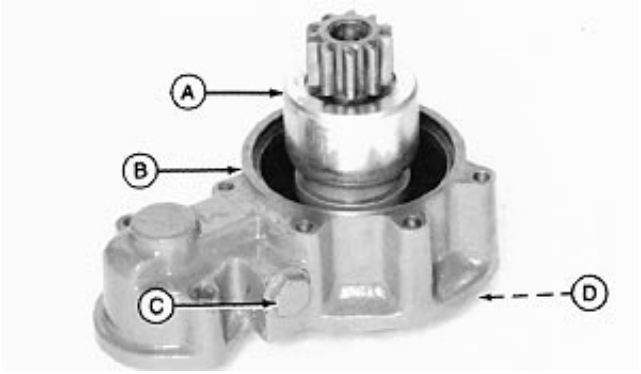
65
10
25

RG,RG34710,2316 –19–15MAR97–1/9

3. Place shift lever and overrunning clutch (A) up into center bearing housing (B).
4. Install shift lever pivot (C) through shift lever and tighten to specifications.

Specification	
Shift Lever Pivot Cap Screw— Torque	41 N•m (30 lb-ft)

5. Bend washered edge of shift lever pivot down to prevent loosening.
6. Lubricate bearing in center bearing housing generously, but not excessively with either Esso Beacon 325 or Delco-Remy Lubricant No. 1960954.
7. Inspect O-ring (D) for wear and damage. Replace if necessary.



RG3907 –UN–09NOV89

Install and Inspect

A—Overrunning Clutch
B—Center Bearing Housing
C—Shift Lever Pivot
D—O-Ring

Continued on next page

RG,RG34710,2316 –19–15MAR97–2/9

8. Carefully install armature into field frame (A).

9. Place center bearing housing with overrunning clutch assembly (B) onto armature shaft (C) and against field frame.

   Make sure O-ring in center bearing housing is not twisted or crimped when placed against field frame.

10. Slide pinion stop over ring using a washer (F) and two pair of pliers.

11. Remove washer.

12. Tighten all center bearing housing cap screws (G) in field frame to specifications.

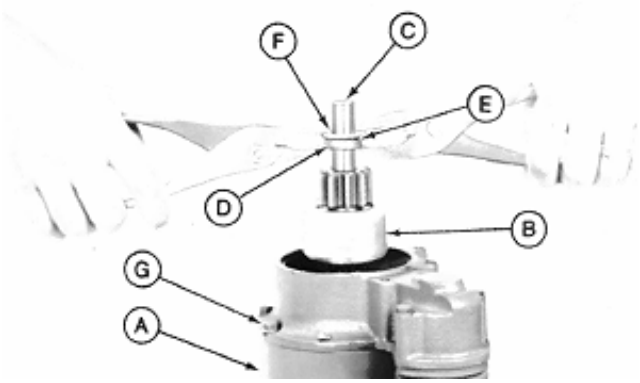
Specification

Center Housing-to-Field Frame
Cap Screw—Torque ..... 8 N•m (71 lb-in.)

NOTE: Before installing drive end housing, check armature end play. Using a dial indicator, place a tip against end of armature shaft on drive end. If end play is not within specifications, add or remove shims (37, see exploded view) to obtain correct end play.

Specification

Armature End Play—Torque ..... 0.05—0.50 mm (0.002—0.020 in.)



RG3908 –UN–09NOV89

Install Center Bearing Housing

A—Field Frame
B—Overrunning Clutch Assembly
C—Armature Shaft
D—Pinion Stop
E—Retaining Ring
F—Washer (remove after using)
G—Cap Screws

RG,RG34710,2316 –19–15MAR97–3/9

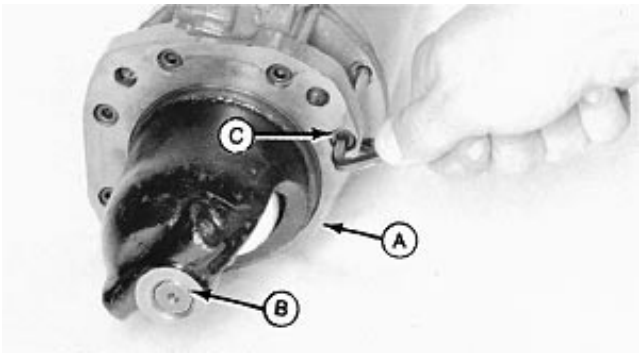
13. Install drive end housing (A) against center bearing housing. Armature shaft must come through drive end bushing (B).

14. Tighten drive end Allen-head bolts (C) to specifications.

Specification

Drive End Housing-to-Center
Housing Cap Screws—Torque ..... 14 N•m (124 lb-in.)

A—Drive End Housing
B—Drive End Bushing
C—Drive End Allen-Head Bolts



RG4205 –UN–08SEP89

Install Drive End Housing

Continued on next page

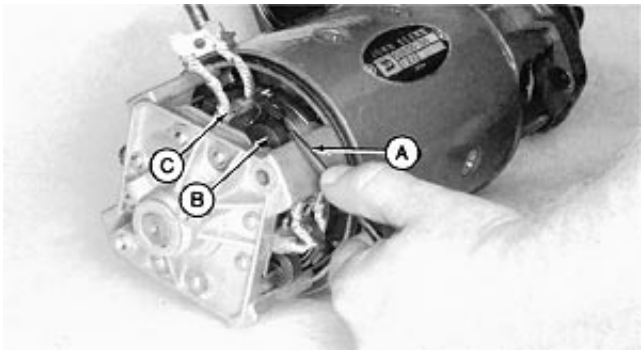
RG,RG34710,2316 –19–15MAR97–4/9

15. Place commutator end frame over armature.

NOTE: Be sure commutator end frame notches fit correctly in field frame.

16. Using O-ring pick (A) or other suitable tool, raise brush springs (B) and install brushes (C).

A—O-Ring Pick
B—Brush Springs
C—Brushes



RG3902 –UN–09NOV89

Install Brushes

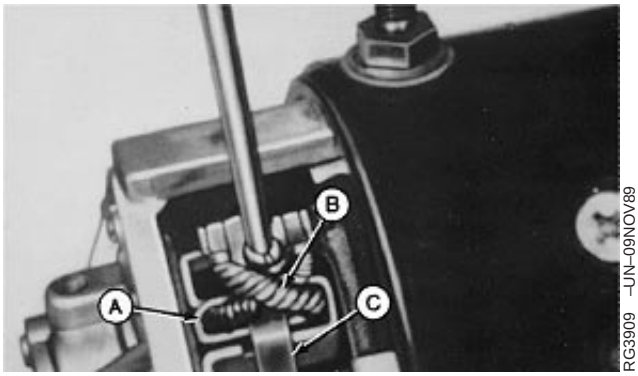
65
10
27

RG,RG34710,2316 –19–15MAR97–5/9

17. Twist brush leads (B) 180 degrees.

18. Press leads of insulated brush (A) down against brush. Make sure spring (C) is fully seated on top of brush.

A—Insulated Brush
B—Brush Leads
C—Spring



RG3909 –UN–09NOV89

Twist Brush Leads

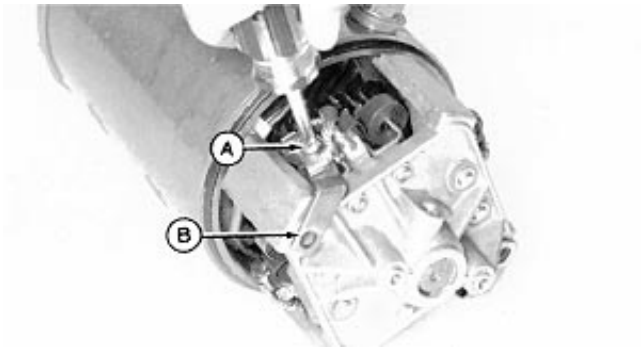
RG,RG34710,2316 –19–15MAR97–6/9

19. Install brush ground straps (B).

20. Screw brush cap screws (A) down securely.

NOTE: Make sure field winding lead and shunt winding leads are tightened down with the brush cap screws.

A—Brush Cap Screws
B—Brush Ground Straps



RG3901 –UN–09NOV89

Install Brush Ground Straps

Continued on next page

RG,RG34710,2316 –19–15MAR97–7/9

21. Install washers and cap screws (B) through commutator end frame.

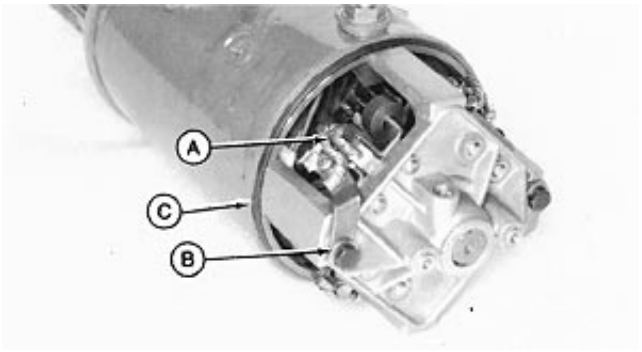
22. Tighten screws to specifications.

Specification

Commutator End Frame Cap Screws—Torque ..... 14 N•m (124 lb-in.)

Make sure brush leads (A) are properly positioned.

NOTE: Replace O-ring (C) if cracked or worn.



RG3900 –UN–09NOV89

Position Brush Leads

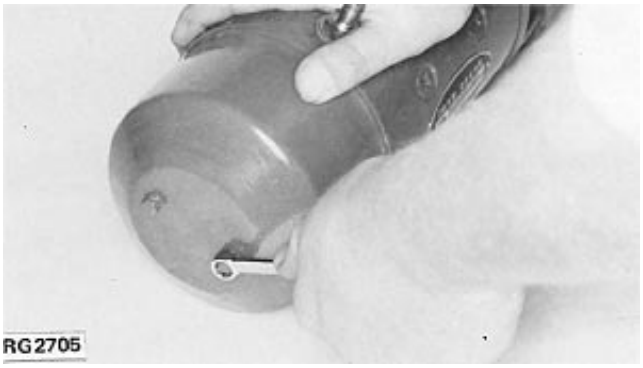
65
10
28

A—Brush Leads
B—Washers and Cap Screws
C—O-Ring

RG,RG34710,2316 –19–15MAR97–8/9

23. Place end frame cover onto field frame.

24. Install end frame cover washers, lock washers and cap screws. Tighten securely.



RG2705 –UN–17JUL89

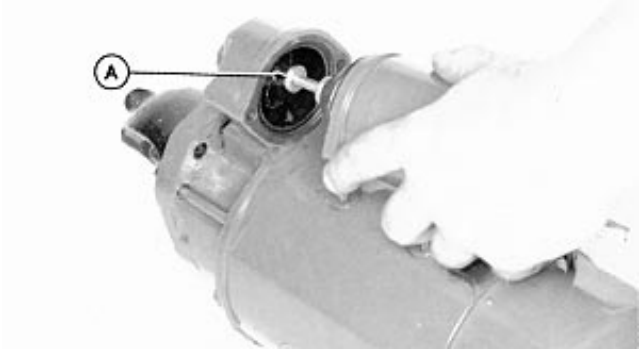
End Frame Cover

RG,RG34710,2316 –19–15MAR97–9/9

Install Solenoid

1. Install solenoid plunger shaft (A) up onto shift lever.

A—Solenoid Plunger Shaft



RG3899 –UN–09NOV89

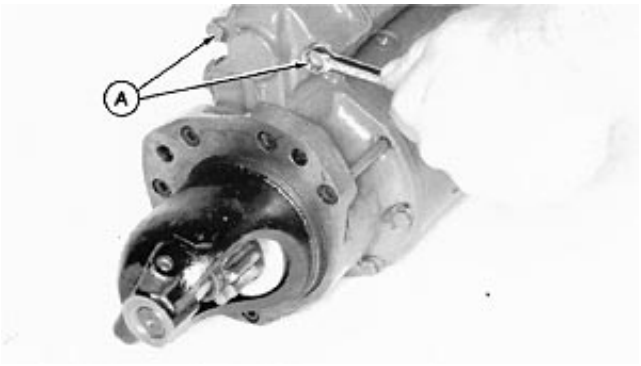
Solenoid Plunger Shaft

Continued on next page

RG,RG34710,2317 –19–15MAR97–1/4

2. Push solenoid assembly forward up against center bearing housing.
3. Screw solenoid cap screws with lock washers (A) into solenoid and tighten securely.

A—Solenoid Cap Screws and Lock Washers



Lock Washers

RG,RG34710,2317 –19–15MAR97–2/4

65
10
29

4. Install field coil connector (A), washers and nuts. Tighten nuts securely.

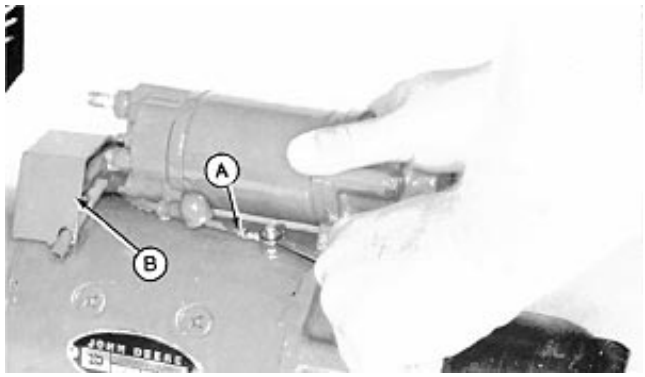
A—Field Coil Connector

Install Field Coil Connector

RG,RG34710,2317 –19–15MAR97–3/4

5. Install shunt lead wire (A), lock washer, and nut. Tighten nut securely.
6. Install terminal cover (B) on solenoid securely.

A—Shunt Lead Wire
B—Terminal Cover

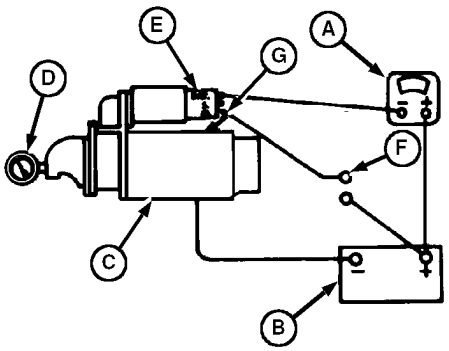


Install Terminal Cover

RG,RG34710,2317 –19–15MAR97–4/4

Make No-Load Test

1. Make connections as shown, and use an ammeter (A) capable of measuring several hundred amps.
2. Measure current draw and compare with specifications given earlier in this group.
3. If speed and current draw are slightly low, connect a voltmeter between motor terminal and frame. Observe voltage during test. Voltage may be reduced because of high current draw on battery.
4. If speed or current draw is significantly different than specified, diagnose problem by referring to Diagnose No-Load Test chart earlier in this group.



RG11163 –UN–28SEP00

Make No-Load Test

A—Ammeter
B—Battery
C—Start Frame
D—Tachometer
E—Battery Terminal
F—Switch
G—Field Coil Connector

65
10
30

RG,RG34710,2318 –19–15MAR97–1/1

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B9F –19–08MAY02–1/3

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUO1004,0000B9F –19–08MAY02–2/3

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000B9F –19–08MAY02–3/3

Service Equipment and Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC). Some tools may be available from a local supplier.

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000BA0 –19–25SEP00–1/5

65
15
2

Armature Growler

Test windings for shorts.

OUO1004,0000BA0 –19–25SEP00–2/5

Bearing Puller. D01203AA

Remove bearings.

OUO1004,0000BA0 –19–25SEP00–3/5

Bearing Puller. D01217AA

Remove bearings.

OUO1004,0000BA0 –19–25SEP00–4/5

Bushing, Bearing and Seal Drive Set. D01045AA

Remove and install all commutator, drive end, and center bushings.

OUO1004,0000BA0 –19–25SEP00–5/5

Other Material

Number	Name	Use
	Mineral Spirits	Clean armature, solenoid and brushes.
	00 Sandpaper	Clean commutator.
	ESSO Beacon 325 or Delco-Remy No. 1960954 Lubricant	Lubricate various stator components.

OUO1004,0000BA1 –19–25SEP00–1/1

John Deere/Denso Gear Reduction Starter Motor Repair Specifications

Item	Measurement	Specification
Armature	Undercut Depth Service Minimum	0.08 mm (0.031 in.) 0.20 mm (0.008 in.)
Commutator	OD (New Part) Wear Limit	36 mm (1.41 in.) 35 mm (1.38 in.)
Commutator	Runout (New Part) Wear Limit	0.02 mm (0.0008 in.) 0.05 mm (0.002 in.)
Negative Brushes	Minimum Length	9.0 mm (0.35 in.)
Field Coil Brushes	Minimum Length	12.7 mm (0.500 in.)

OUO1004,0000BA2 –19–25SEP00–1/1

John Deere/Denso Gear Reduction Starter Motor Test Specifications

John Deere Starter Motor Part No.	Denso Starter Motor Part No.	System Voltage	Rating Type	kW	Motor Voltage	No Load Test Current Draw Amps (Max.)	RPM (Min.)
AM879743	22800-7111	12	R	2.0	11		
AM877284	22800-	12	R	2.0	11		
RE19275	028000-8400	12	R	2.5	11	180	3500
RE40092	028000-8290	12	R	2.5	11	200	3000
RE500199	228000-7010	24	R	7.5	23	120	3800
RE501060	228000-7410, 228000-7411	24	R	7.8	23 Min	120	3800
RE501294	228000-7873	12	R	4.0	11	220	4200
RE50165	228000-0840	12	R	2.5	11	200	3000
RE51447	028000-8401	12	R	2.5	11	200	3000
RE54090	128000-8291	12	R	2.5	11	200	3000
RE54091	228000-0841	12	R	2.5	11	200	3000
RE54092	028000-8402	12	R	2.5	11	200	3000
RE59588	228000-0844	12	R	2.5	11	200	3000
RE59595	128000-8294	12	R	2.5	11	200	3000
RE68470	228000-6471	12	R	2.7	11	200	3000
RE69704	228000-6530, 228000-6531	12	R	4.0	11	220	4200
RE69705	228000-6560	24	R	7.5	23	120	3800
RE70473	228000-6540	12	R	4.8	11	220	4200
RE70474	228000-6550, 228000-6551	12	R	4.8	11	220	4200
RE70475	228000-6570	24	R	7.5	23	120	3800
RE70957	228000-6530	12	R	4.8	11	220	4200
RE70959	228000-6540	12	R	4.8	11	220	4200
RE70960	228000-6550	12	R	4.8	11	220	4200

NOTE: Earlier Denso starter motors may have the original Nippondenso label.

RG,RG34710,2322 –19–07JUL05–1/1

Bench Test Starter Motor

IMPORTANT: Never operate starter motor more than 30 seconds. Allow at least 2 minutes for cooling and battery recovery before operating again. Overheating, caused by excessive operation, will seriously damage starter motor.

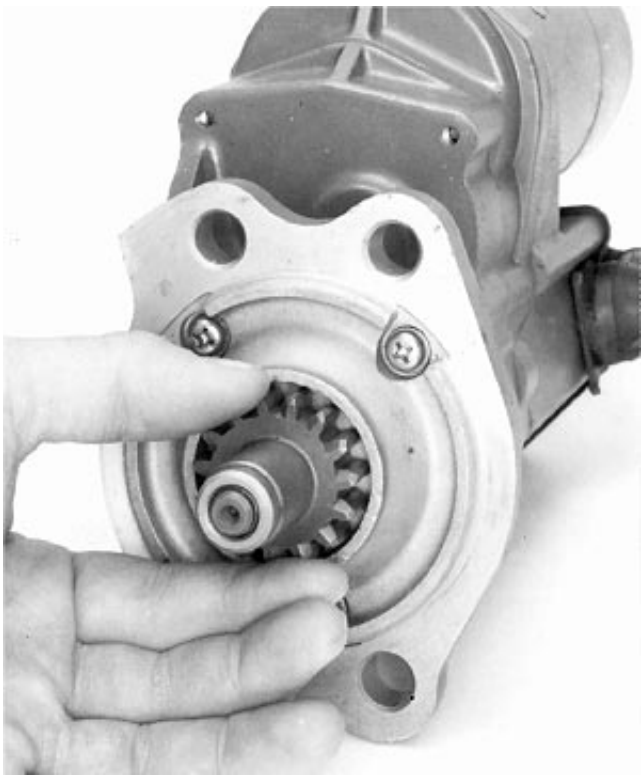
NOTE: Perform bench tests before disassembling the starter motor to determine the cause of the problem.

1. Turn overrunning clutch drive clockwise by hand. Pinion should turn freely.

2. Turn pinion counterclockwise. A definite resistance should be felt. If clutch assembly is defective, disassemble the starter clutch.

3. If armature turns freely and the clutch is not defective, test starter under no-load conditions as follows.

NOTE: Starter motors illustrated in this group are equipped with a four-hole mounting flange instead of one that has two holes. In addition, later R 4.0 kW and R 7.5 kW starter motors have the brush assemblies at the opposite end of the armature. Service procedures are not affected.



RW2158 –UN–06MAR90

Turn Overrunning Clutch

RG,RG34710,2323 –19–15MAR97–1/1

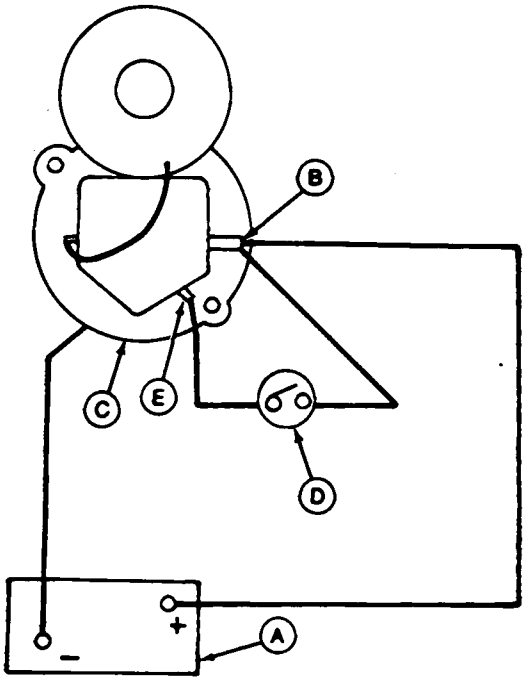
65
15
5

No-Load Test

NOTE: Do not conduct the no-load test unless the armature turns freely.

1. Connect a 12-volt battery (A) to starter battery terminal (B) and starter frame (C) as shown. Use heavy-duty cables.
2. Connect a remote start switch (D) between switch terminal (E) and battery terminal (B).
3. When switch is activated, starter should engage and run.
4. If solenoid only chatters, hold-in winding is open-circuited. If nothing happens, either the pull-in winding is open-circuited or mechanical parts are sticking. To check for sticking, remove solenoid end cover and push plunger by hand.
5. If solenoid engages properly, but motor does not run, check main contact points, bearings, brushes, reduction gears, armature, and field windings.

NOTE: The solenoid cannot be repaired, although mechanical parts may be replaced. Disassemble solenoid to determine cause of problem.



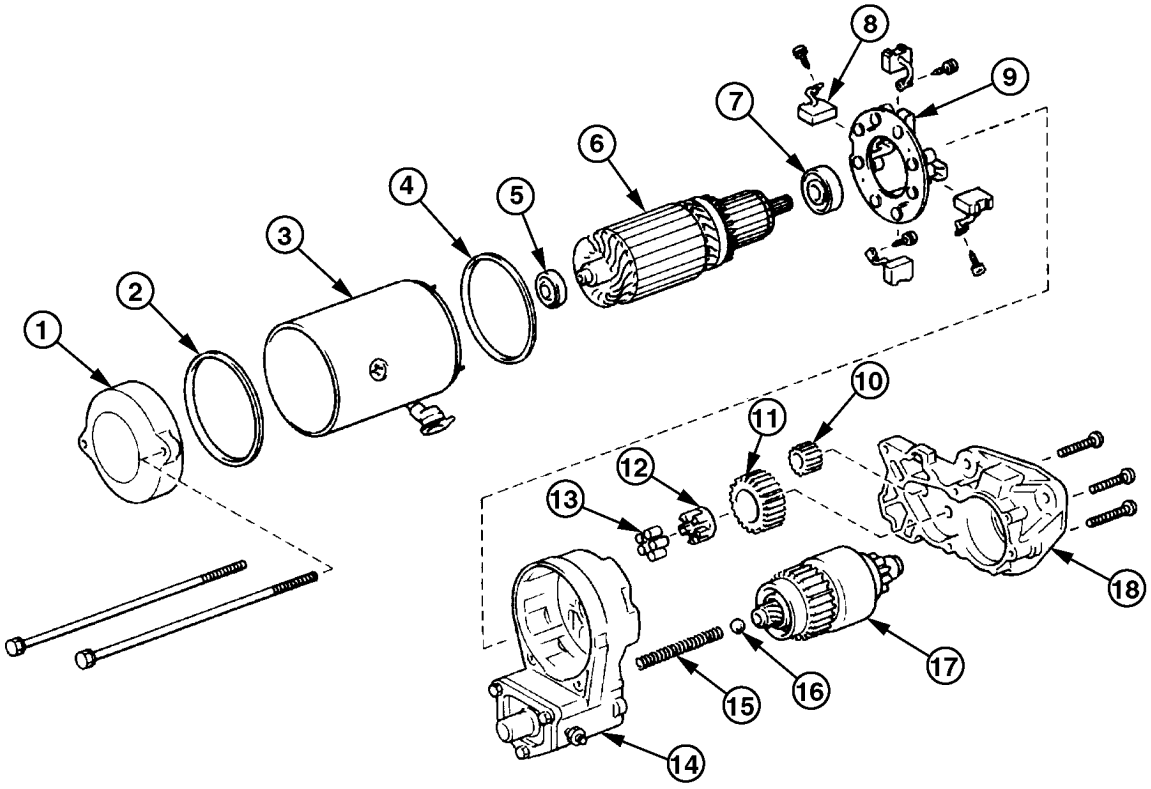
RW2159 –UN–01DEC88

No-Load Test

A—12-Volt Battery
B—Battery Terminal
C—Starter Frame
D—Remote Start Switch
E—Switch Terminal

RG,RG34710,2324 –19–15MAR97–1/1

John Deere/Denso Gear Reduction Starter Motor Exploded View



RG8615 –UN–16SEP99

Gear-Reduction Starter Motor

1—End Frame
2—O-Ring
3—Field Frame
4—O-Ring
5—Rear Bearing
6—Armature
7—Front Bearing
8—Brush (4 Used)
9—Brush Holder
10—Drive Gear
11—Idler Gear
12—Retainer
13—Roller (5 Used)
14—Solenoid Assembly
15—Return Spring
16—Steel Ball
17—Overrunning Clutch
18—Motor Frame

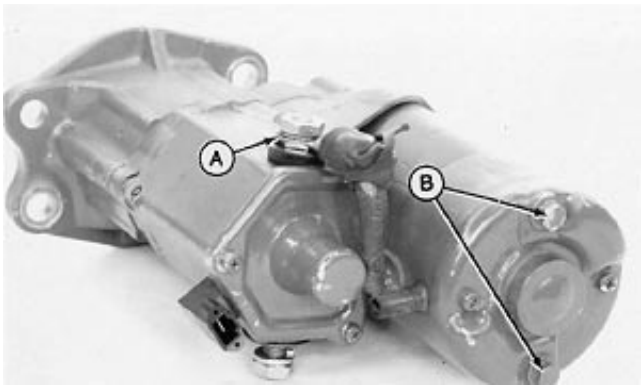
RG,RG34710,2334 –19–15MAR97–1/1

Disassemble Field Frame, Armature, and Brush Holder

NOTE: Bench test the starter motor before disassembly.

1. Disconnect field lead (A) from solenoid.
2. Remove two through bolts (B) and separate field frame assembly from motor frame.

A—Field Lead
B—Through Bolts (2 Used)



RW10058 –UN–10NOV89

Disconnect Field Lead

Continued on next page

RG,RG34710,2325 –19–15MAR97–1/4

3. Remove two screws from brush end cap and remove cap from frame assembly.

RW10059 –UN–10NOV89

Remove Cap from Frame Assembly

RG,RG34710,2325 –19–15MAR97–2/4

4. Lift two field coil brush springs away and pull field coil brushes (A) away from brush holder assembly.

A—Field Coil Brushes

RW10067 –UN–10NOV89

Field Coil Brushes

Continued on next page

RG,RG34710,2325 –19–15MAR97–3/4

5. Lift two negative brush springs away and pull brushes back about 6 mm (0.250 in.). Release springs to hold brushes in place in brush holder (A).
6. Remove brush holder from frame assembly and armature.
7. Remove armature from frame assembly.

A—Brush Holder

RW10068 –UN–10NOV89

Brush Holder

65
15
9

RG,RG34710,2325 –19–15MAR97–4/4

Inspect and Repair Armature

1. Remove armature from field frame assembly. See Disassemble Field Frame, Armature and Brush Holder earlier in this group.

IMPORTANT: Do not clean armature with solvent. Solvent could damage insulation on windings. Use only mineral spirits and a brush.

2. Visually inspect armature. Look for signs of dragging against pole shoes.

Specification

Armature—Undercut Depth	0.08 mm (0.031 in.)
Service Minimum	0.20 mm (0.008 in.)

RW2166 –UN–06MAR90

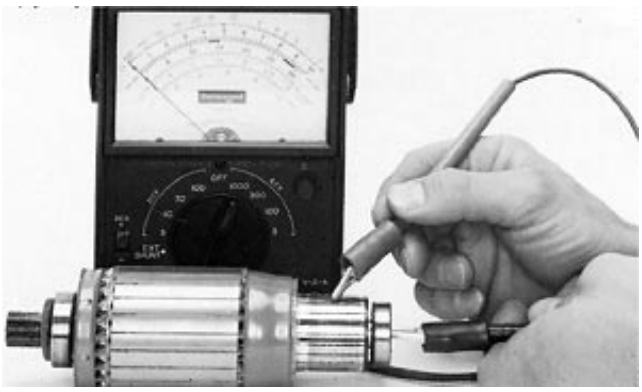
Inspect and Repair Armature

Continued on next page

RG,RG34710,2326 –19–15MAR97–1/8

3. Check for grounded windings using an ohmmeter as shown, or a test lamp. Place ohmmeter probes on commutator bar and armature shaft. If test shows continuity (needle movement) a winding is grounded and the armature must be replaced.

NOTE: Operating symptoms of grounded windings would be that the starter motor cranks engine slowly or not at all. On no-load test, the starter motor would have low armature speed and high current draw, or fail to operate and have high current draw.



RW2167 –UN–26FEB93

Ohmmeter

65
15
10

RG,RG34710,2326 –19–15MAR97–2/8

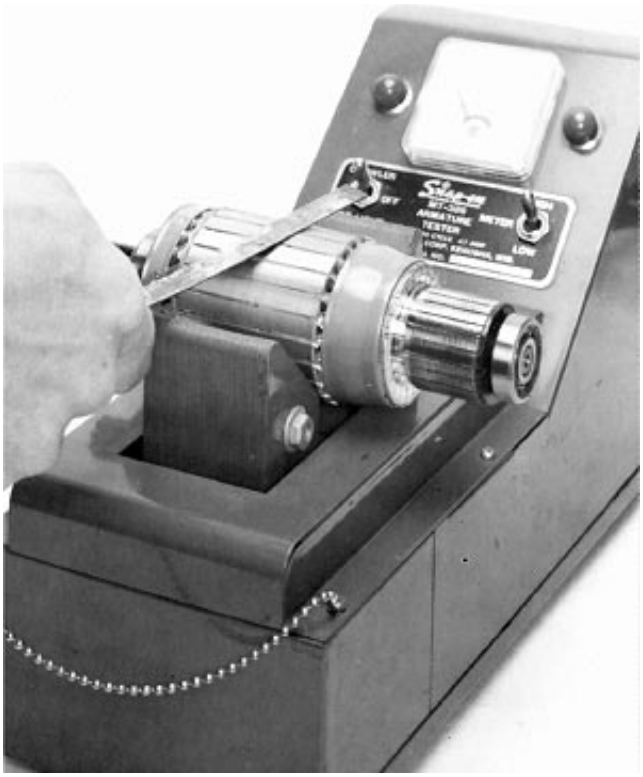
NOTE: Operating symptoms of short-circuited windings would be that the starter motor cranks engine slowly. On no-load test, motor has low armature speed and high current draw.

4. Check for short-circuited windings using a growler such as shown.

5. Place armature in growler and hold a hacksaw blade above each slot while slowly rotating the armature. The blade will be attracted to and repelled (vibrating motion) from the slot.

NOTE: A short circuit most often occurs because of copper dust or fillings between two commutator segments.

6. If test indicates short-circuited windings, clean the commutator of dust and filings and recheck the armature. If test still indicates a short circuit, replace the armature.



RW2168 –UN–01DEC88

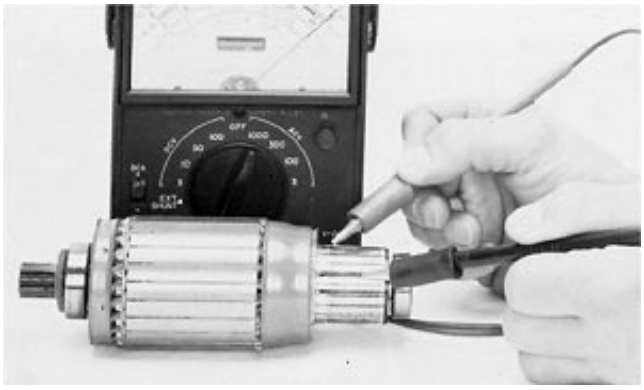
Growler

Continued on next page

RG,RG34710,2326 –19–15MAR97–3/8

7. Check for open-circuited windings using an ohmmeter as shown, or a test lamp. Place ohmmeter probes on two different commutator bars. If test shows no continuity (no needle movement), there is an open circuit and the armature must be replaced.

NOTE: Operating symptoms of open-circuited windings would be that the starter motor cranks engine slowly. On no-load test, motor has low armature speed and high current draw.



Ohmmeter Probes

65
15
11

RG,RG34710,2326 –19–15MAR97–4/8

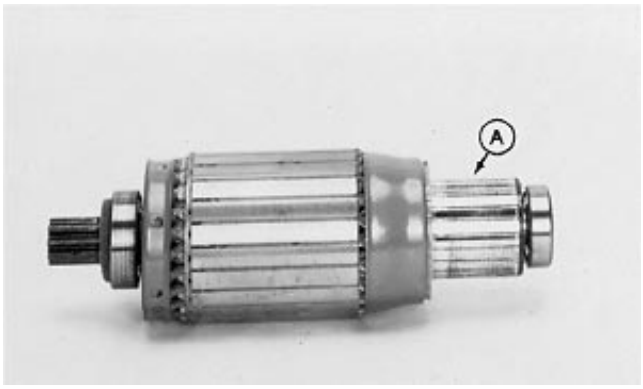
8. Check commutator (A), looking for roughness or burned commutator bars.

9. If necessary, clean and touch up with 00 sandpaper. NEVER use emery cloth. Clean all dust from armature when finished.

10. Turn down slightly on a lathe if commutator is out of round, badly burned, or rough. Remove only enough metal to eliminate the problem. After turning down, undercut the insulation between bars to 0.5—0.8 mm (0.019—0.031 in.) deep. Touch up commutator with sandpaper and clean metal chips and dust from armature when finished.

Specification

Commutator—OD (New Part)	36 mm (1.41 in.)
Wear Limit	35 mm (1.38 in.)
Commutator—Runout (New Part)	0.02 mm (0.0008 in.)
Wear Limit	0.05 mm (0.002 in.)



Check Commutator

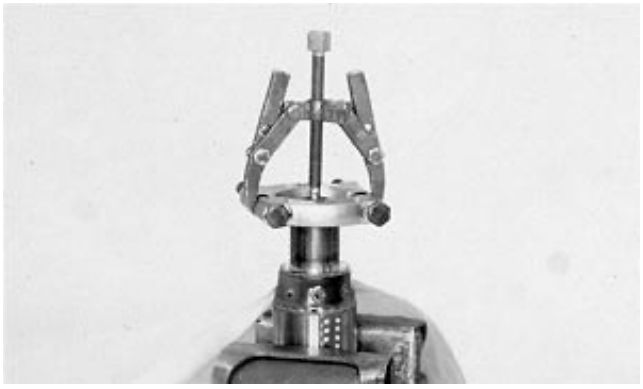
A—Commutator

Continued on next page

RG,RG34710,2326 –19–15MAR97–5/8

11. Inspect front and rear armature bearings for smooth, quiet operation. Replace as necessary.

12. Remove bearings by using D01217AA Bearing Puller and D01203AA Bearing Puller as shown.



RW10069 –UN–10NOV89

Front and Rear Armature Bearings

RG,RG34710,2326 –19–15MAR97–6/8

IMPORTANT: Install both bearings with the sealed side toward the middle of the armature.

13. Install new bearing on the rear of armature using a piece of 15.88 mm (0.625 in.) ID pipe (A) drilled out to 17.45 mm (0.687 in.) ID. Be sure to drive only on the inner race. Make sure bearing is tight against shoulder of shaft.

NOTE: Pipe must be drilled out to the larger size to allow it to pass over the splined end of the armature.

A—15.88 mm (0.625 in.) ID Pipe

RW10070 –UN–10NOV89

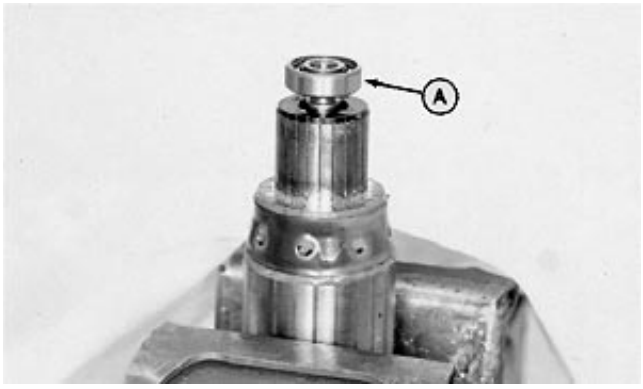
15.88 mm (0.625 in.) ID Pipe

Continued on next page

RG,RG34710,2326 –19–15MAR97–7/8

14. Install bearing (A) with sealed side of bearing toward middle of armature on commutator end of armature using 27491 1/2 in. driver disk from D01045AA Bushing, Bearing and Seal Drive Set. Drive only on the inner race. Install bearing until tight against shoulder of shaft.

A—Bearing



RW10071 –UN–10NOV89

Install Bearing

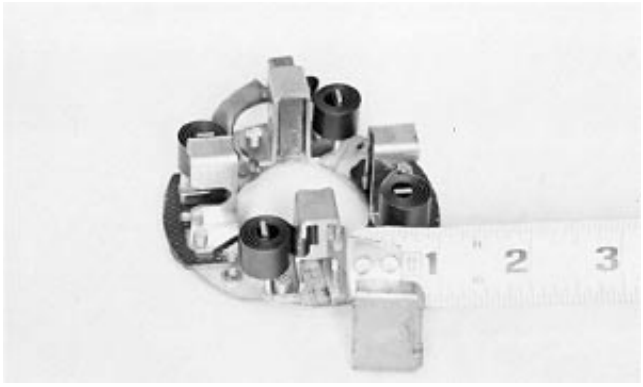
RG,RG34710,2326 –19–15MAR97–8/8

Inspect Brushes and Brush Holder

1. Measure negative brushes mounted on brush holder. If worn below specification, replace the brush holder assembly.

Specification

Negative Brushes—Minimum Length	9.0 mm (0.35 in.)



RW10072 –UN–10NOV89

Measure Negative Brushes

Continued on next page

RG,RG34710,2327 –19–15MAR97–1/4

2. Measure the field coil brushes attached to the field frame assembly. If worn below specified length, replace the entire field frame assembly.

Specification

Field Coil Brushes—Minimum Length..... 12.7 mm (0.500 in.)

RW10073 –UN–10NOV89

Measure Field Coil Brushes

65
15
14

RG,RG34710,2327 –19–15MAR97–2/4

3. Test the brush holder using an ohmmeter as shown, or a test light. Place one lead of tester to the negative brush holder and the other lead to field brush holder. If there is continuity (needle movement), replace the brush holder.

RW10074 –UN–10NOV89

Test Brush Holder with Ohmmeter

Continued on next page

RG,RG34710,2327 –19–15MAR97–3/4

4. Check the brush springs to be sure they are not weak or distorted. Replace as necessary.

5. Remove spring using a pair of needle nose pliers. Raise brush end of spring from holder and pry spring upward from lug on holder with a screwdriver.

6. To install, start spring on lug and wind spring so brush end of spring fits in brush holder, while at the same time pushing the spring on the lug.

RW10075 –UN–10NOV89

Check Brush Springs

65
15
15

RG,RG34710,2327 –19–15MAR97–4/4

Inspect Field Coils

1. Check for grounded field winding using an ohmmeter as shown, or a test light. Touch one lead to a field coil brush and the other lead to the field frame. Be sure the brush lead is not touching the frame. If there is continuity (needle movement), the coil is grounded and the field frame assembly must be replaced.

RW10076 –UN–10NOV89

Check for Grounded Field Winding

Continued on next page

RG,RG34710,2328 –19–12SEP02–1/2

2. Check for open field coil using an ohmmeter as shown, or a test light. Touch a lead to each field coil brush. If there is no continuity (no needle movement), the field coil is open and the field frame assembly must be replaced.

RW10077 –UN–10NOV89

Check for Open Field Coil

RG,RG34710,2328 –19–12SEP02–2/2

Assemble Field Frame, Armature, and Brush Holder

1. Place armature in field frame assembly and place in vise.
2. Lift the two negative brush springs away and pull brushes back about 6 mm (0.250 in.). Release the spring to lock the brushes in the outward position.
3. Place brush holder on armature and frame assembly.

RW10095 –UN–10NOV89

Field Frame, Armature and Brush Holder

Continued on next page

RG,RG34710,2329 –19–15MAR97–1/5

4. Lift two field coil brush springs away from holder and place brushes (A) in holders. Allow springs to hold brushes against commutator.

5. Push negative brushes inward to allow springs to hold brushes against commutator.

A—Brushes

RW10067 –UN–10NOV89

Place Brushes in Holders

65
15
17

RG,RG34710,2329 –19–15MAR97–2/5

6. Apply a small amount of Delco-Remy Lubricant No. 1960954, or equivalent, to the open side of the brush end bearing.

7. Install brush end cap in place and install and tighten two screws from brush end cap to field frame assembly.

RW10059 –UN–10NOV89

Install Brush End Cap

Continued on next page

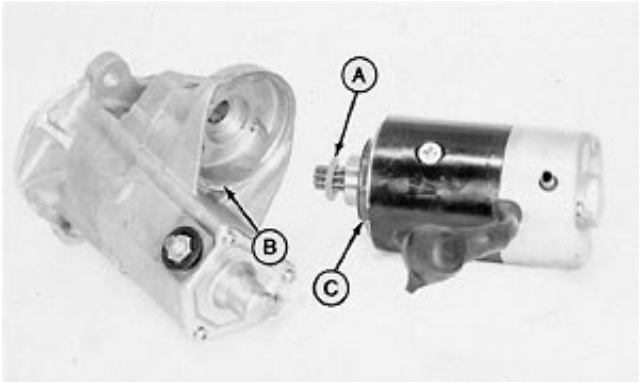
RG,RG34710,2329 –19–15MAR97–3/5

8. Apply a small amount of Delco-Remy Lubricant No. 1960954, or equivalent, to the open side of the drive end bearing.

9. Install felt washer (A) in place on armature shaft.

10. Align indexing slot in solenoid frame (B) with flange on lip of field frame assembly (C).

NOTE: Some starter motors may have a small-square shaped locking key which fits into the cast slot (B) in solenoid frame.



RW10078 –UN–10NOV89

Install Felt Washer

A—Felt Washer
B—Indexing Slot
C—Field Frame Assembly

65
15
18

RG,RG34710,2329 –19–15MAR97–4/5

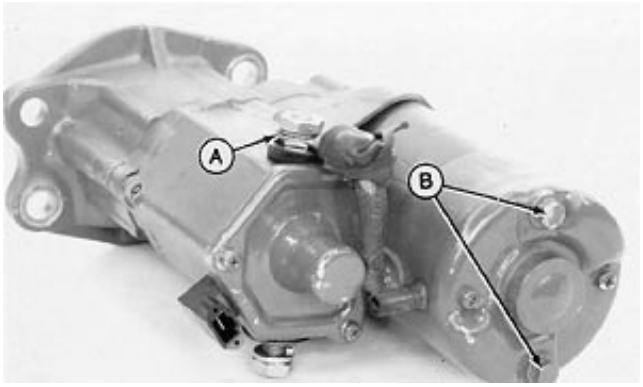
11. Install field frame assembly to motor frame.

12. Install and tighten two through bolts (B).

13. Connect field lead (A) to solenoid.

14. Bench test the repaired starter motor as instructed earlier in this group.

15. If bench tests indicate that the starter motor is working, install starter motor on engine as instructed in machine technical manual.



RW10058 –UN–10NOV89

Connect Field Lead to Solenoid

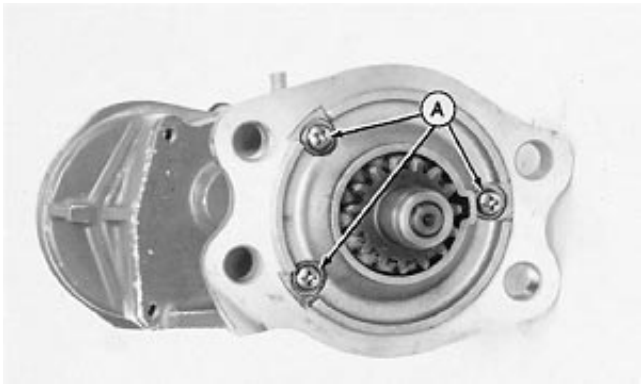
A—Field Lead
B—Through Bolts (2 Used)

RG,RG34710,2329 –19–15MAR97–5/5

Disassemble Gear Train and Overrunning Clutch

1. Disassemble the field frame assembly from the housing as previously instructed in this group.
2. Remove three screws (A) and separate gear train assembly from motor frame.

A—Screws (3 Used)

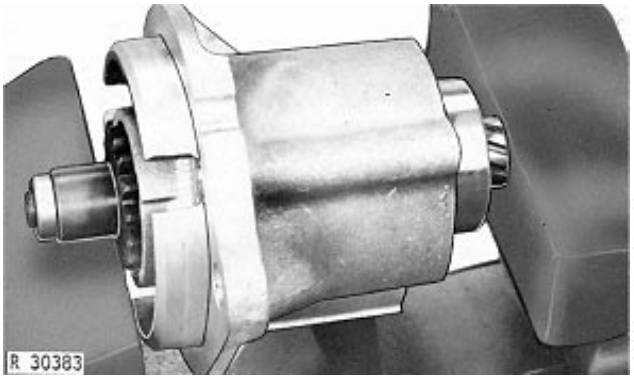


RW10062 –UN–10NOV89

Remove Screws

RG,RG34710,2330 –19–15MAR97–1/6

3. Place gear assembly in a soft-jaw vise as shown. Be sure rear vise jaw is against shaft and front jaw is against pinion.
4. Slowly tighten vise until pinion compresses.



R30383 –UN–12FEB90

Compress Pinion

Continued on next page

RG,RG34710,2330 –19–15MAR97–2/6

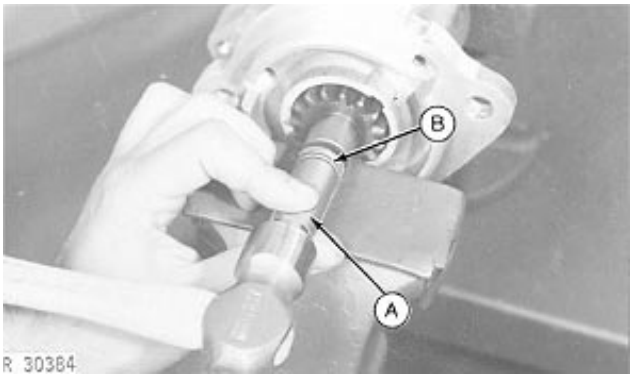
5. Drive back retainer (B) until snap ring is exposed, using a short length of 5/8 in. ID pipe (A).

6. Remove snap ring and retainer from pinion shaft.

CAUTION: Shaft could be propelled from clutch unit with considerable force, if spring is not allowed to extend fully while in vise.

7. Slowly open vise until all spring tension is relieved and remove gear assembly from vise.

A—5/8 in. ID Pipe
B—Retainer



R30384 –UN–12FEB90

Remove Snap Ring and Retainer

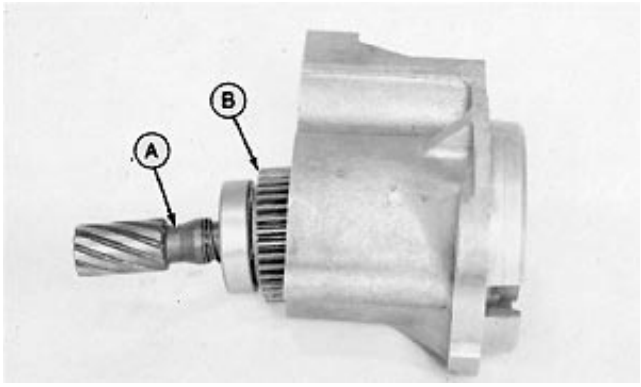
65
15
20

RG,RG34710,2330 –19–15MAR97–3/6

8. Remove drive pinion from shaft.

9. Remove shaft with springs (A) and clutch unit (B) from housing.

A—Shaft with Springs
B—Clutch Unit



RW10080 –UN–10NOV89

Remove Shaft

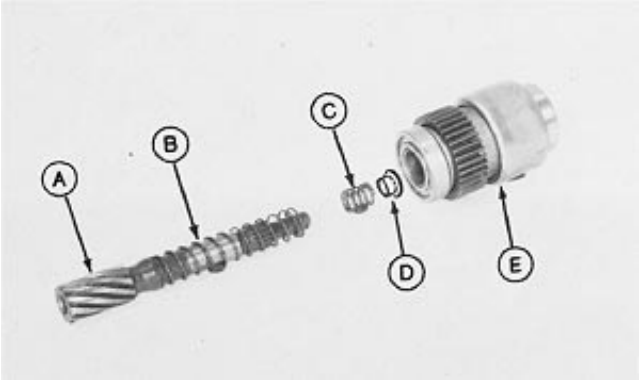
Continued on next page

RG,RG34710,2330 –19–15MAR97–4/6

10. Inspect all parts for wear or damage. Replace as necessary.

11. If clutch unit (E) is defective, the entire unit must be replaced.

A—Shaft
B—Spring
C—Spring
D—Retainer
E—Clutch Unit



RW10081 –UN–10NOV89

Inspect Parts for Wear or Damage

65
15
21

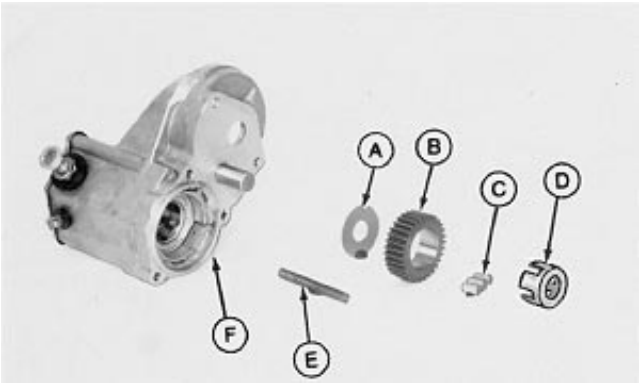
RG,RG34710,2330 –19–15MAR97–5/6

12. Remove the starter pinion (B), needle roller retainer (D) with six needle rollers (C), and thrust washer (A) from housing.

13. Remove the spring (E) from the solenoid plunger.

14. Inspect all parts for wear or damage. Replace as necessary.

A—Thrust Washer
B—Pinion
C—Needle Rollers (6 used)
D—Needle Roller Retainer
E—Solenoid Plunger Spring
F—Solenoid Housing



RW10082 –UN–10NOV89

Inspect Parts

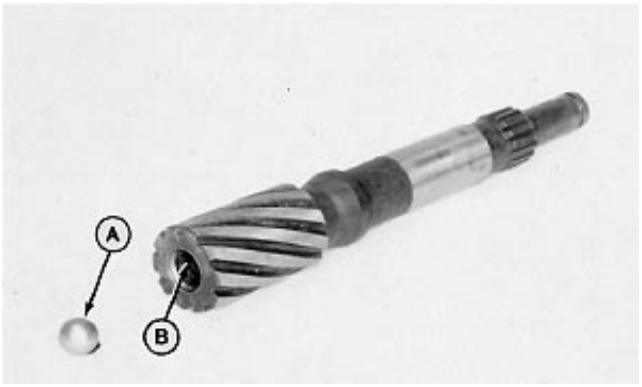
RG,RG34710,2330 –19–15MAR97–6/6

Assemble Gear Train and Overrunning Clutch

NOTE: Use Delco-Remy No. 1960954 Lubricant or a similar lubricant when assembling starter motor.

1. Make sure the solenoid plunger ball (A) is in place in the shaft bore (B). Apply a light coat of grease to the ball to hold in place.

A—Solenoid Plunger Ball
B—Shaft Bore



RW10079 –UN–10NOV89

Solenoid Plunger Ball in Shaft Bore

65
15
22

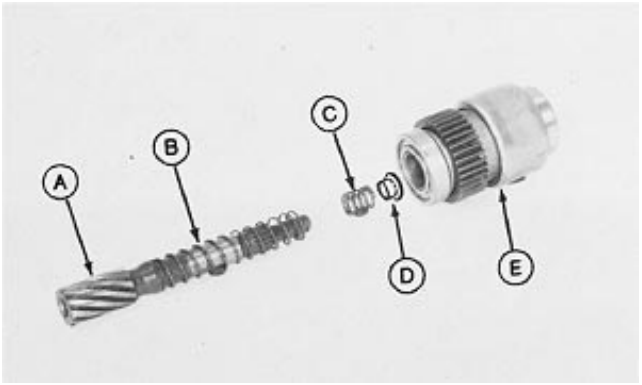
RG,RG34710,2331 –19–15MAR97–1/7

NOTE: Lubricate the shaft lightly with lubricant before installing springs.

2. First place the long spring (B) on the pinion shaft, then the short spring (C), and spring retainer (D).

3. Install pinion shaft assembly into clutch unit (E), as shown.

A—Pinion Shaft
B—Spring
C—Spring
D—Spring Retainer
E—Clutch Unit



RW10081 –UN–10NOV89

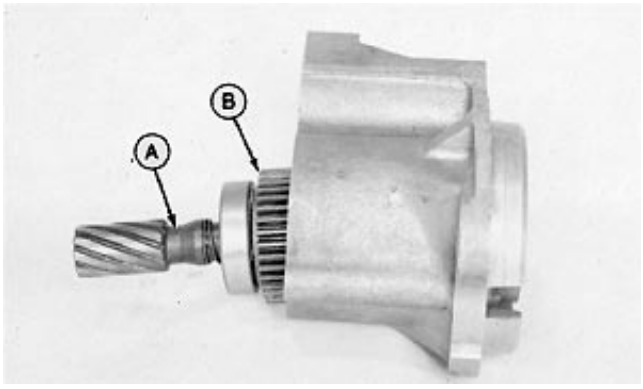
Install Pinion Shaft Assembly into Clutch Unit

Continued on next page

RG,RG34710,2331 –19–15MAR97–2/7

4. Install clutch unit (B) with pinion shaft assembly (A) into housing.

A—Pinion Shaft Assembly
B—Clutch Unit



RW10080 –UN–10NOV89

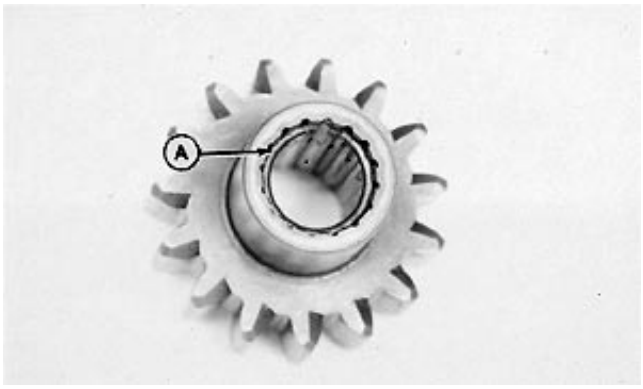
Clutch Unit with Pinion Shaft Assembly

65
15
23

RG,RG34710,2331 –19–15MAR97–3/7

5. Make sure retaining ring (A) is in drive pinion and is not worn or damaged.

A—Retaining Ring



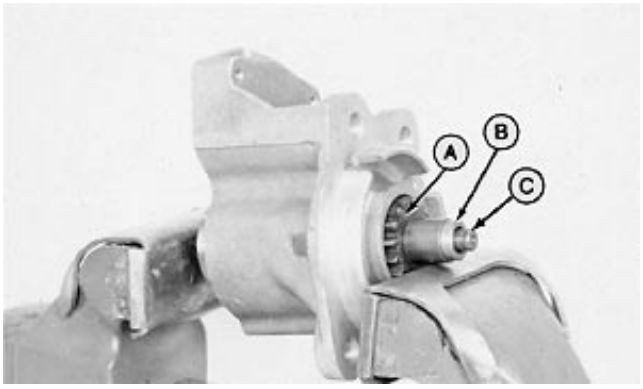
RW10083 –UN–10NOV89

Retaining Ring

Continued on next page

RG,RG34710,2331 –19–15MAR97–4/7

6. Lightly lubricate the pinon shaft and install drive pinion (A) onto pinion shaft, as shown, with large flange to the outside of clutch.
7. Place gear assembly in a soft jaw vise, as shown. Be sure rear vise jaw is against shaft and front jaw is against pinion.
8. Slowly tighten vise until pinion compresses enough to allow installation of retainer and retaining ring.
9. Install retainer (B) and snap ring (C) and remove from vise. Make sure snap ring is seated in retainer.



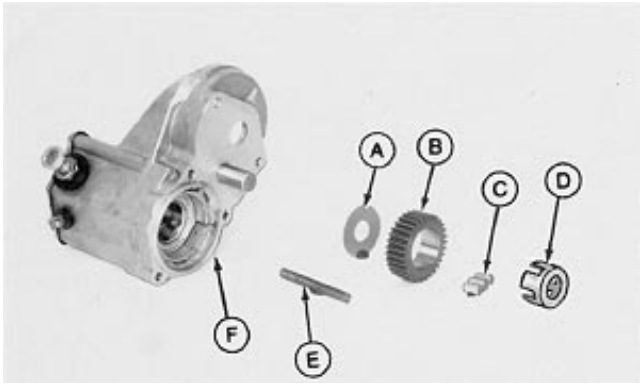
RW10084 –UN–10NOV89

Install Retainer and Snap Ring

A—Drive Pinion
B—Retainer
C—Snap Ring

RG,RG34710,2331 –19–15MAR97–5/7

10. Apply a thin coating of lubricant to the thrust washer (A) and install on shaft.
11. Apply a thin coating of lubricant to the needle rollers (C) and install them into retainer (D).
12. Install the needle roller retainer with needle rollers into the starter pinion (B).
13. Place the pinion assembly onto the shaft with the open side of the retainer facing the thrust washer.
14. Install spring (E) on solenoid plunger.



RW10082 –UN–10NOV89

Components

A—Thrust Washer
B—Pinion
C—Needle Rollers (6 used)
D—Needle Roller Retainer
E—Solenoid Plunger Spring
F—Solenoid Housing

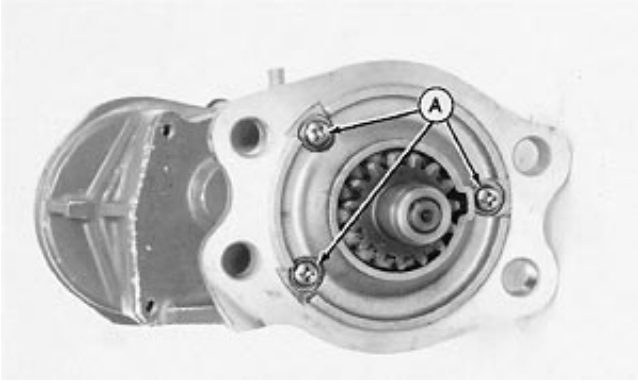
Continued on next page

RG,RG34710,2331 –19–15MAR97–6/7

15. Assemble gear train assembly to frame and install and tighten three screws (A).

16. Assemble field frame assembly to housing and bench test the starter as previously instructed in this group.

A—Screws (3 Used)



RW10062 –UN–10NOV89

Screws

RG,RG34710,2331 –19–15MAR97–7/7

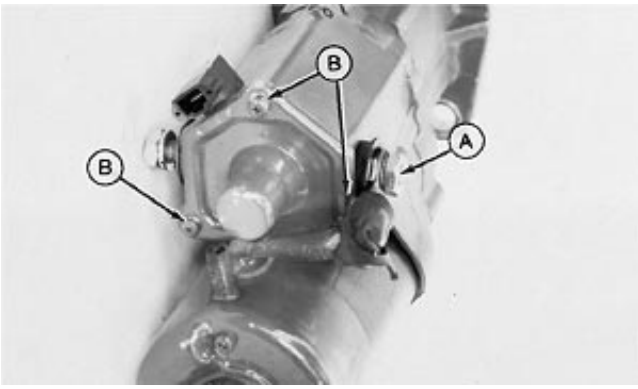
Disassemble, Inspect, and Repair Starter Solenoid

1. Remove starter motor from engine.

2. Disconnect field frame lead (A).

3. Remove three screws (B) and remove solenoid cover and gasket.

A—Field Frame Lead
B—Screws (3 Used)



RW10086 –UN–10NOV89

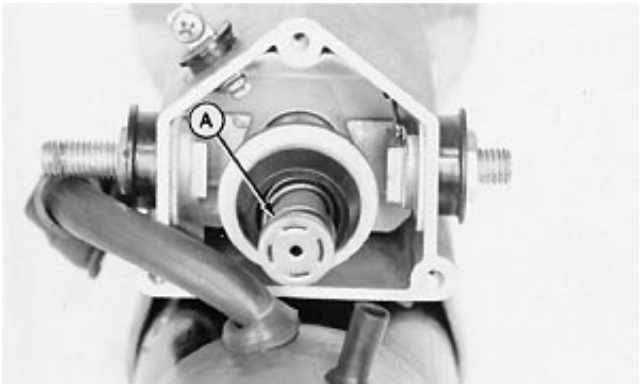
Remove Solenoid Cover and Gasket

Continued on next page

RG,RG34710,2332 –19–15MAR97–1/3

4. Remove plunger (A).

A—Plunger



RW10087 –UN–10NOV89

Remove Plunger

RG,RG34710,2332 –19–15MAR97–2/3

5. Remove plunger spring (A).

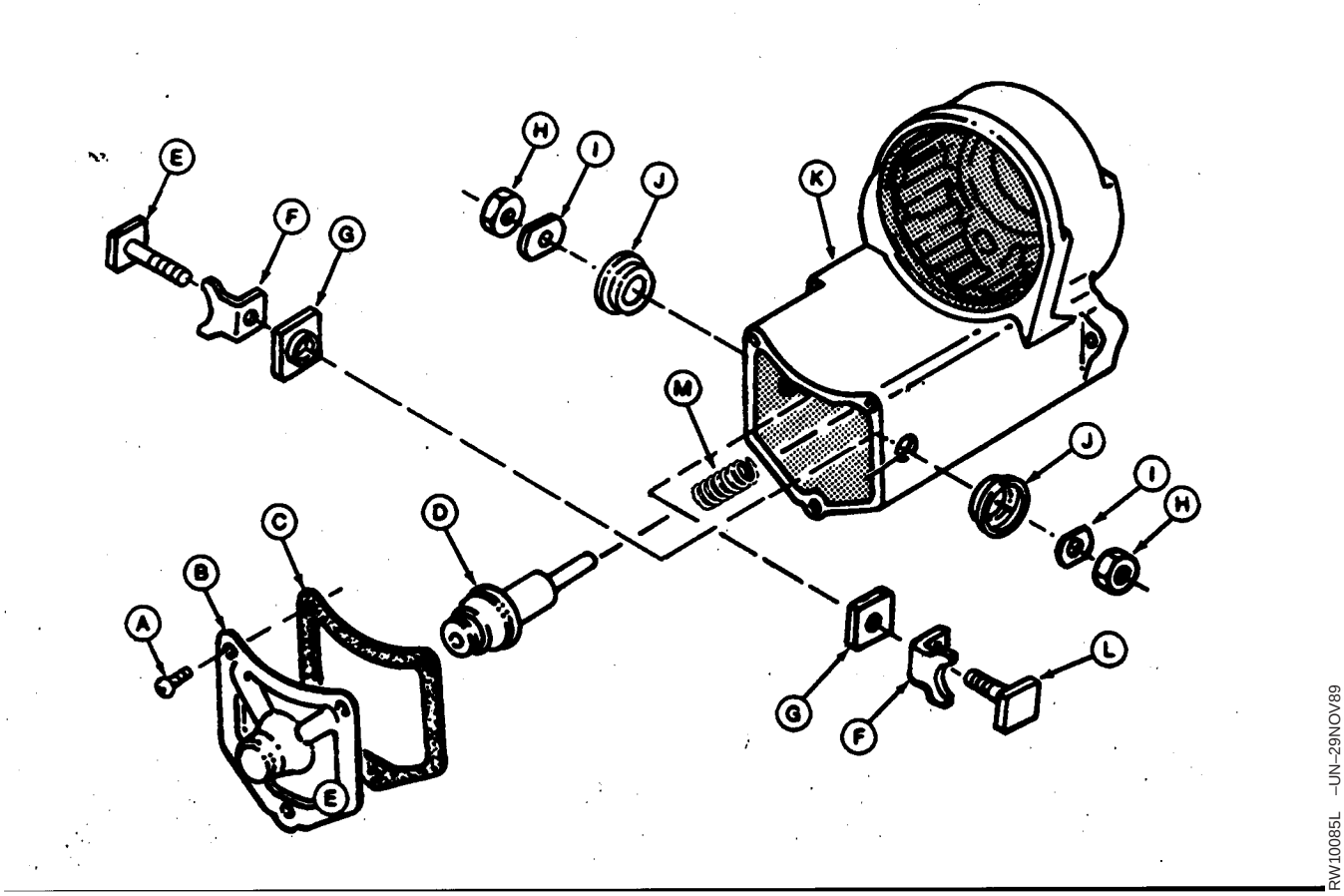
A—Plunger Spring

RW10088 –UN–10NOV89

Remove Plunger Spring

RG,RG34710,2332 –19–15MAR97–3/3

Assemble Solenoid Assembly



Exploded View of Solenoid Assembly

A—Screw (3 Used)
B—Solenoid Cover
C—Gasket
D—Plunger
E—Bolt
F—Plate (2 Used)
G—Bushing (2 Used)
H—Nut (2 Used)
I—Special Washer (2 Used)
J—Bushing
K—Solenoid Housing
L—Bolt
M—Plunger Spring

1. Inspect all solenoid components shown and replace as necessary if broken or worn.

2. The complete solenoid housing must be replaced if there is a solenoid problem other than the loose parts shown.

Continued on next page

RG,RG34710,2333 –19–15MAR97–1/4

3. Place plunger spring (A) in housing.

A—Plunger Spring

RW10088 –UN–10NOV89

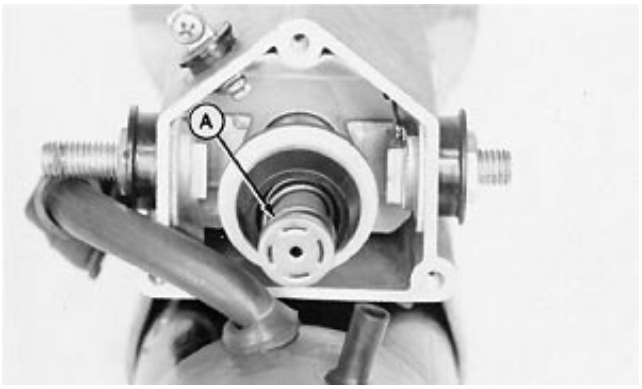
Plunger Spring

65
15
28

RG,RG34710,2333 –19–15MAR97–2/4

4. Place solenoid plunger (A) into spring in housing.

A—Plunger



RW10087 –UN–10NOV89

Solenoid Plunger

Continued on next page

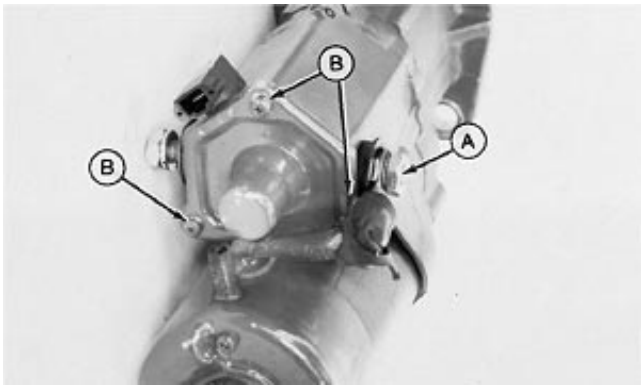
RG,RG34710,2333 –19–15MAR97–3/4

5. Carefully inspect gasket and replace if hard and brittle or torn.

6. Install solenoid cover and gasket onto solenoid housing and install and tighten three screws (B).

7. Connect field frame lead (A).

A—Field Frame Lead
B—Screws (3 Used)



RW10086 –UN–10NOV89

Connect Field Frame Lead

65
15
29

RG,RG34710,2333 –19–15MAR97–4/4

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000B9B –19–08MAY02–1/3

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUO1004,0000B9B –19–08MAY02–2/3

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000B9B –19–08MAY02–3/3

Other Material

Number	Name	Use
	Mineral Spirits	Clean armature, solenoid and brushes.
	00 Sandpaper	Clean commutator.
	Moribten Grease 7129 or equivalent	Lubricate various components.

OUO1004,0000B9D –19–25SEP00–1/1

65
20
2

John Deere/Denso Planetary Starter Motor Repair Specifications

Item	Measurement	Specification
New Brush	Length	26 mm (1.02 in.)
Used Brush	Minimum Length	18 mm (0.71 in.)
Brush Spring	Minimum Tension	26.5 N (6.0 lb-force)
Brush Lead Screws	Torque	2.2—3.4 N•m (19.4—30.1 lb-in.)
Drive End Housing-to-Center Housing Cap Screws	Torque	17.6—25.4 N•m (13.0—18.7 lb-ft)
Rear End Cover to Field Frame Bolts (M8)	Torque	26.5—29.4 N•m (19.5—21.7 lb-ft)
Brush Holder Assy to Rear Cover Nut (Ground Terminal) (1/2 in.)	Torque	27.5—33.3 N•m (20.3—24.5 lb-ft)
Brush Holder Assy to Rear Cover Nut (1/4 in.)	Torque	3.2—4.4 N•m (28.3—38.9 lb-in.)
Solenoid to Center Housing Cap Screws (M6)	Torque	10.5—14.5 N•m (7.7—10.7 lb-ft)
”M” Terminal Nut (1/2 in.)	Torque	19.6—29.4 N•m (14.4—21.7 lb-ft)
Shunt Field Terminal Nut (Yoke) (M5)	Torque	2.94—4.71 N•m (26.0—41.6 lb-in.)

OUOD006,000004B –19–08JUL02–1/1

John Deere/Denso Planetary Starter Motor Test Specifications

John Deere Starter Motor Part No.	Denso Starter Motor Part No.	System Voltage	Rating Type	kW	Motor Voltage	No Load Test Current Draw Amps (Max.)	RPM (Min.)
RE506825	428000-0120	12	P	5.0	11.5	200	2000
RE506826	428000-0130	24	P	8.0	23.5	120	2000

OUOD006,000004C –19–07JUL05–1/1

Test Starter Motor Before Disassembly

IMPORTANT: Never operate starter motor more than 30 seconds. Allow at least 2 minutes for cooling and battery recovery before operating again. Overheating, caused by excessive operation, will seriously damage starter motor.

1. Turn overrunning clutch drive by hand. Clutch drive should turn freely on shaft in overrunning direction only.

RG12475 –UN–05JUL02

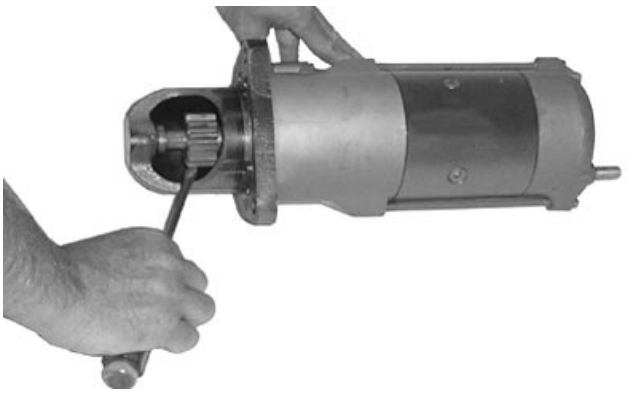
Turn Overrunning Clutch Drive

OUOD006,0000043 –19–05JUL02–1/2

2. Turn armature by prying against pinion with screwdriver. Check for dragging armature, seized bushings, or bent shaft.

   If you discover any interference, disassemble and repair starter motor.

IMPORTANT: Do not conduct the no-load test unless armature turns freely. Damage to the starter motor may result.



RG12476 –UN–05JUL02

Turn Armature

OUOD006,0000043 –19–05JUL02–2/2

Make Solenoid Pull-In Test

IMPORTANT: To prevent damage, solenoid must be on starter motor when testing the windings.

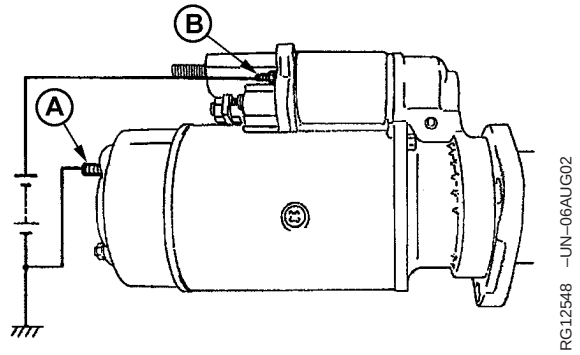
IMPORTANT: To prevent solenoid switch winding from burning, disconnect leads as soon as pinion is at stop. Do not test for more than 3 to 5 seconds.

Make connections as shown, using heavy wire. (Current through wire will be approximately 90 amps.)

65
20
4

NOTE: "50" terminal is terminal for lead from the starting switch.

With 8 volts applied to a 12 volt starter, or 16 volts applied to a 24 volt starter, solenoid should pull the pinion in to the pinion stop and slowly rotate.



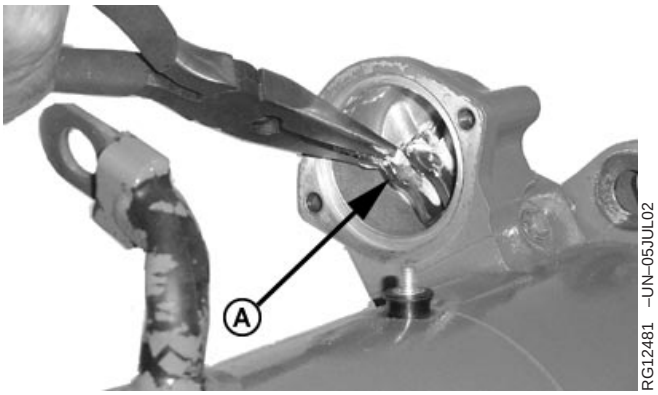
Make Connections

A—Ground Terminal
B—"50" Terminal

OUOD006,0000044 –19–05JUL02–1/2

If solenoid does not engage, remove solenoid (See Steps 1 through 4 of "Disassemble Starter Motor" on following pages), and manually move shift lever (A) back and forth. If lever moves smoothly, pull-in winding is defective and solenoid must be replaced. If not, disassemble and repair starter.

A—Shift Lever



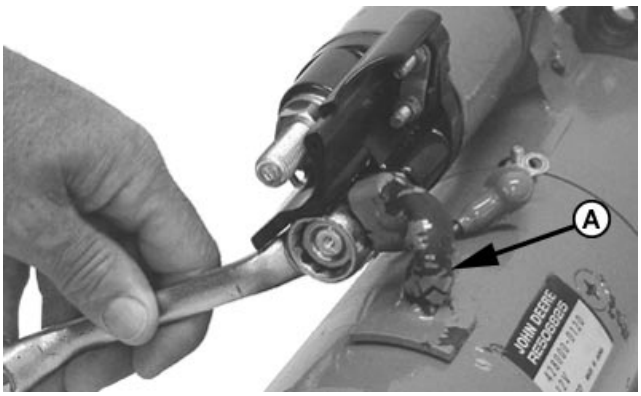
Move Shift Lever

OUOD006,0000044 –19–05JUL02–2/2

Make Solenoid Hold-In Test

After pull-in test, remove the field connector (A). With connections as shown on the previous page for the solenoid pull-in test, and the pinion in the extended position, the pinion should remain in the jumped out (extended) position with a minimum of 3 volts applied for a 12 volt system, or 6 volts for a 24 volt system. If the pinion does not remain in the jumped out position, the hold-in winding or the shunt field winding is defective.

A—Field Coil Connector



Remove Field Coil Connector

65
20
5

OUOD006,0000061 –19–20AUG02–1/2

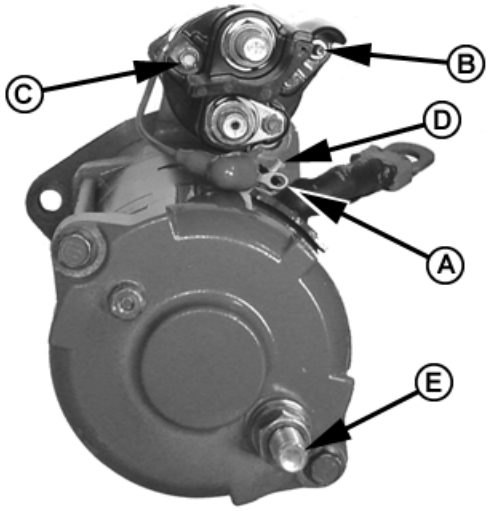
Perform continuity check on hold-in winding and on shunt field winding to determine which is defective (open).

Disconnect power source.

Disconnect shunt field winding lead (A).

Hold-in Winding Check: Connect ohmmeter between “50” terminal (B) and shunt field winding terminal (C) on solenoid. If check indicates hold-in winding is open, replace solenoid.

Shunt Field Winding Check: Connect ohmmeter between shunt field winding terminal (D) at yoke and ground terminal (E). If check indicates shunt field winding is open, the field coils are defective and the starter must be replaced .



Perform Continuity Checks

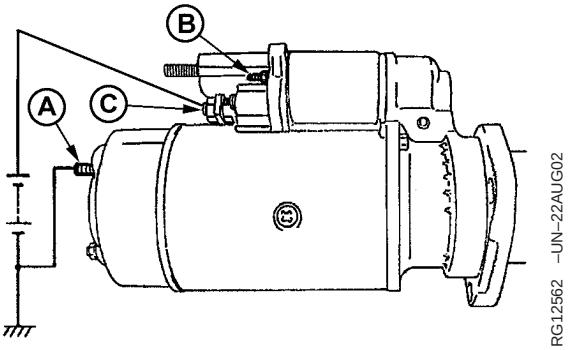
A—Shunt Field Winding Lead
B—”50” Terminal
C—Shunt Field Winding Terminal (Solenoid)
D—Shunt Field Winding Terminal (Yoke)
E—Ground Terminal

OUOD006,0000061 –19–20AUG02–2/2

Make Return Test

After hold-in test, connect jumper wire from battery to motor (“M”) terminal (C), and disconnect the “50” terminal (B) jumper wire. The pinion should return immediately.

A—Ground Terminal
B—”50” Terminal
C—Motor (“M”) Terminal



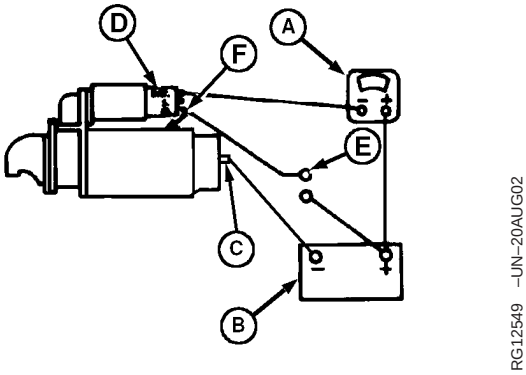
Return Test Connections

OUOD006,0000062 –19–20AUG02–1/1

65
20
6

Make No-Load Test

1. Fasten starter in a vise and, using ammeter (A) (capable of measuring several hundred amps), connect the positive lead of battery (B) to plus (+) terminal of ammeter.
2. Connect ammeter negative (-) terminal to solenoid’s “B” (battery) terminal (D). Also connect “50” terminal (F) through switch (E) to positive lead of battery.
3. Connect battery negative (-) lead to ground terminal (C).
   Starter should show smooth and steady rotation immediately after pinion jumps out, and should draw less than specified current. (Refer to “Test Specifications” at beginning of this group.)



Make Connections

A—Ammeter
B—Battery
C—Ground Terminal
D—“B” (Battery) Terminal
E—Switch
F—“50” Terminal

RG,RG34710,2297 –19–20AUG02–1/1

Diagnose No-Load Test

Fails to Operate-Low Current Draw (Approx. 25 Amps)

Open series field circuit.

Open armature coils.

Defective brush contact with commutator.

Fails to Operate-High Current Draw

Grounded terminal or fields.

Seized bearings.

Low Speed-Low Current Draw

High internal resistance

Defective brush contact with commutator

Low Speed-High Current Draw

Excessive friction

Shorted armature

Grounded armature or fields.

High Speed-Low Current Draw

Open shunt field circuit.

High Speed-High Current Draw

Shorted series field coils.

65
20
7

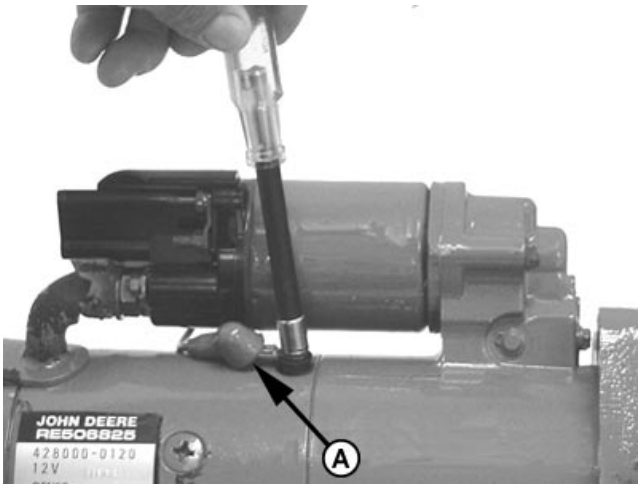
RG,RG34710,2298 –19–15MAR97–1/1

Disassemble Starter Motor

NOTE: Starter motor has metric bolts and nuts except for those on switch cover.

1. Remove shunt field winding lead (A) from terminal on field frame (if not previously removed).

A—Shunt Field Winding Lead



RG12477 –UN–05JUL02

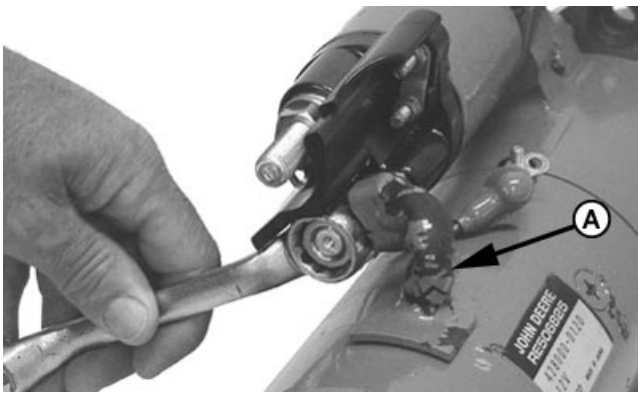
Remove Shunt Field Winding Lead

Continued on next page

OUOD006,0000045 –19–05JUL02–1/11

2. Remove field coil connector (A) (if not previously removed).

A—Field Coil Connector



RG12478 –UN–05JUL02

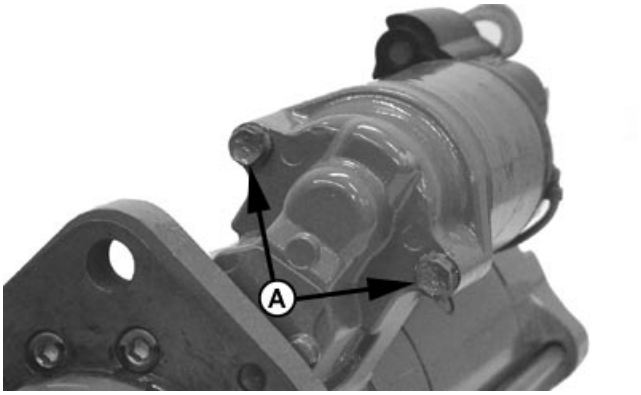
Remove Field Coil Connector

OUOD006,0000045 –19–05JUL02–2/11

3. Remove solenoid cap screws (A).

IMPORTANT: Whenever starter motor is disassembled, for any reason, lubricate as follows: Apply a coat of Moribten Grease 7129 or equivalent to both end bearings. Grease overrunning clutch, planetary shaft , planetary gears, solenoid plunger, both ends of shift lever, wear pads and shift lever pivot shaft.

A—Solenoid Cap Screw (2 used)



RG12479 –UN–05JUL02

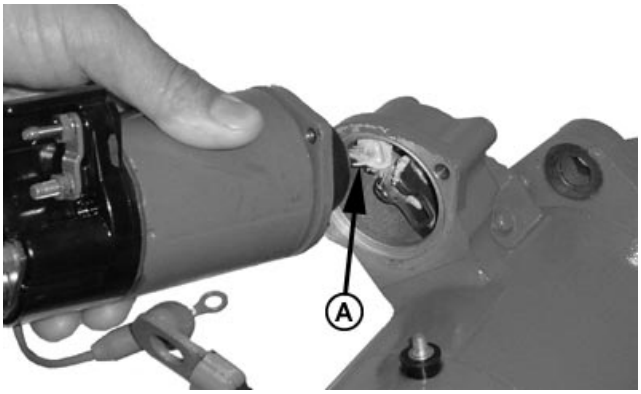
Solenoid Cap Screws

Continued on next page

OUOD006,0000045 –19–05JUL02–3/11

4. Remove solenoid from center bearing housing by lifting plunger shaft (A) up and away from shift lever.

A—Plunger Shaft

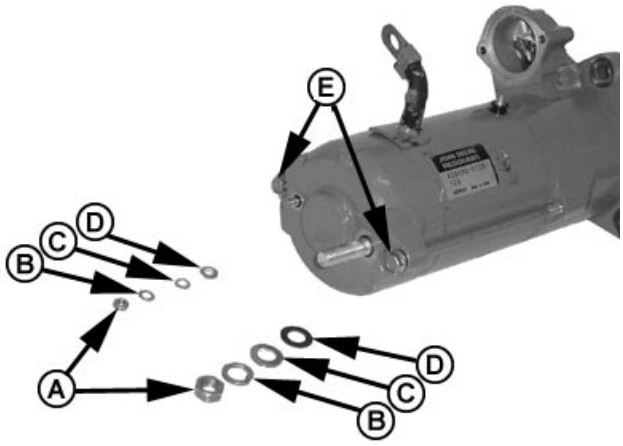


Lift Plunger Shaft

OUOD006,0000045 –19–05JUL02–4/11

5. Remove nuts (A), lock washers (B), flat washers (C) and fiber washers (D) from small and large studs in rear end frame cover.
6. Remove two bolts (E).
7. Remove rear end frame cover.

A—Nut
B—Lock Washer
C—Flat Washer
D—Fiber Washer
E—Bolt (2 used)



Remove End Frame Cover

Continued on next page

OUOD006,0000045 –19–05JUL02–5/11

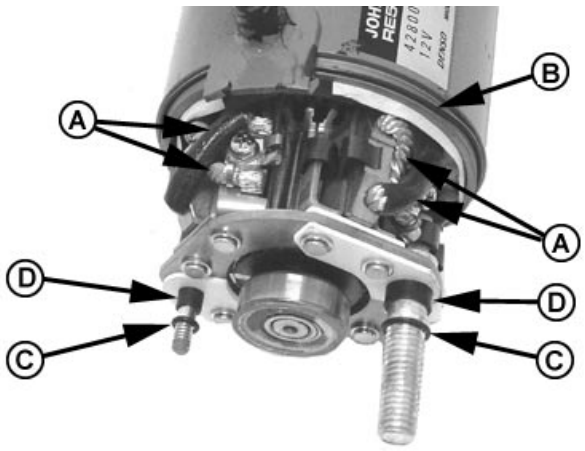
8. Inspect brush leads (A) for fraying or corrosion.

NOTE: If only new brushes are going to be installed, it isn't necessary to remove the commutator end frame.

9. Inspect rear cover O-ring (B) for wear.

10. Inspect O-rings (C) and bushings (D) on small and large studs.

A—Brush Leads (8 used)
B—O-Ring
C—O-Rings
D—Bushings



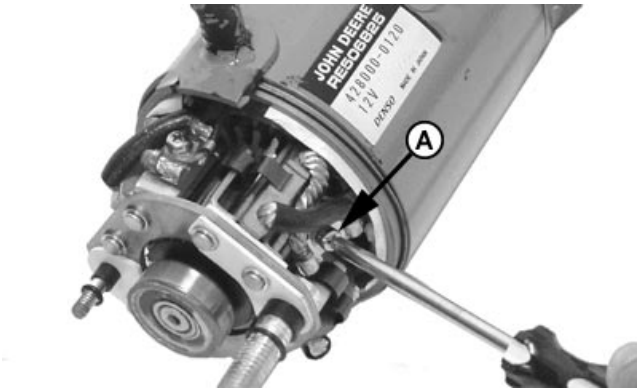
RG12483 –UN–05JUL02

Inspect Brush Leads, O-Rings and Bushings

OUOD006,0000045 –19–05JUL02–6/11

11. Remove brush lead screws (A).

A—Brush Lead Screw (4 used)



RG12484 –UN–05JUL02

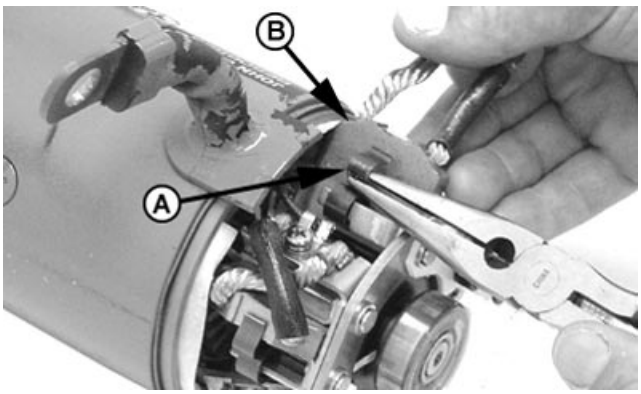
Remove Brush Lead Screws

Continued on next page

OUOD006,0000045 –19–05JUL02–7/11

12. Pull brush spring (A) back and remove brush (B).

A—Brush Spring (4 used)
B—Brush (4 used)



Remove Brushes

OUOD006,0000045 –19–05JUL02–8/11

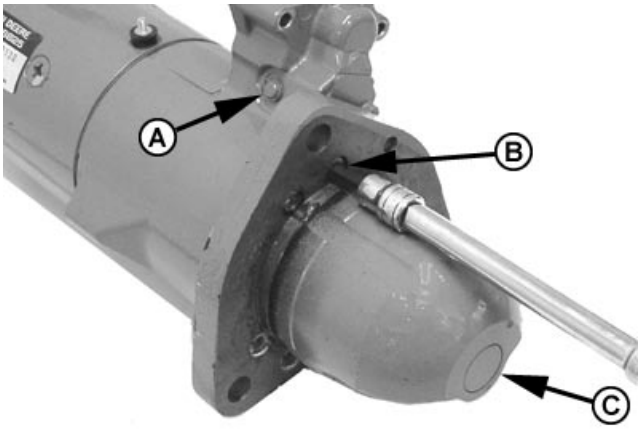
13. Remove snap ring and shift lever pivot (A).

NOTE: Before removal of drive end housing, place alignment marks on drive end housing and center bearing housing for aid in reassembly.

14. Remove drive end housing hex head bolts (B).

15. Remove drive end housing (C).

A—Shift Lever Pivot
B—Hex Head Bolt (6 used)
C—Drive End Housing



Remove Drive End Housing

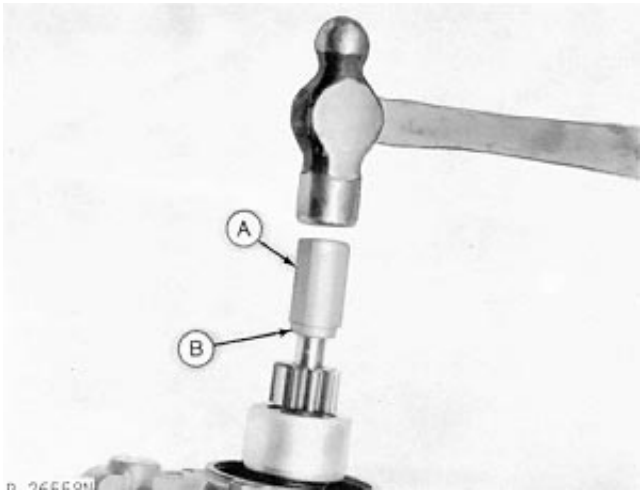
Continued on next page

OUOD006,0000045 –19–05JUL02–9/11

16. Use a pipe coupling (A) or other metal cylinder to drive pinion stop (B) toward pinion.

17. Remove retaining ring and slide pinion stop off shaft.

A—Pipe Coupling
B—Pinion Stop



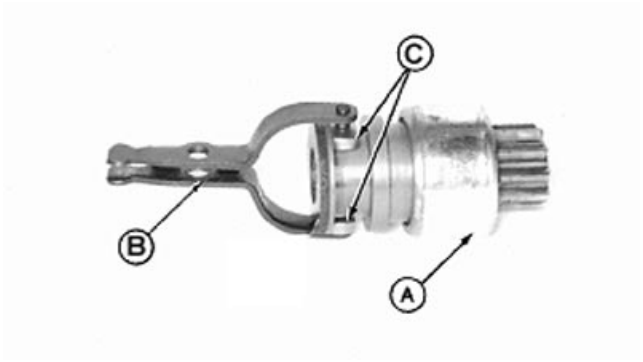
R26558 –UN–09FEB90

Slide Pinion Stop

OUOD006,0000045 –19–05JUL02–10/11

18. Carefully remove overrunning clutch (A), shift lever (B), and wear pads (C) from center bearing housing and armature shaft. Inspect wear pads for excessive wear or damage. Replace wear pads if necessary.

A—Overrunning Clutch
B—Shift Lever
C—Wear Pads

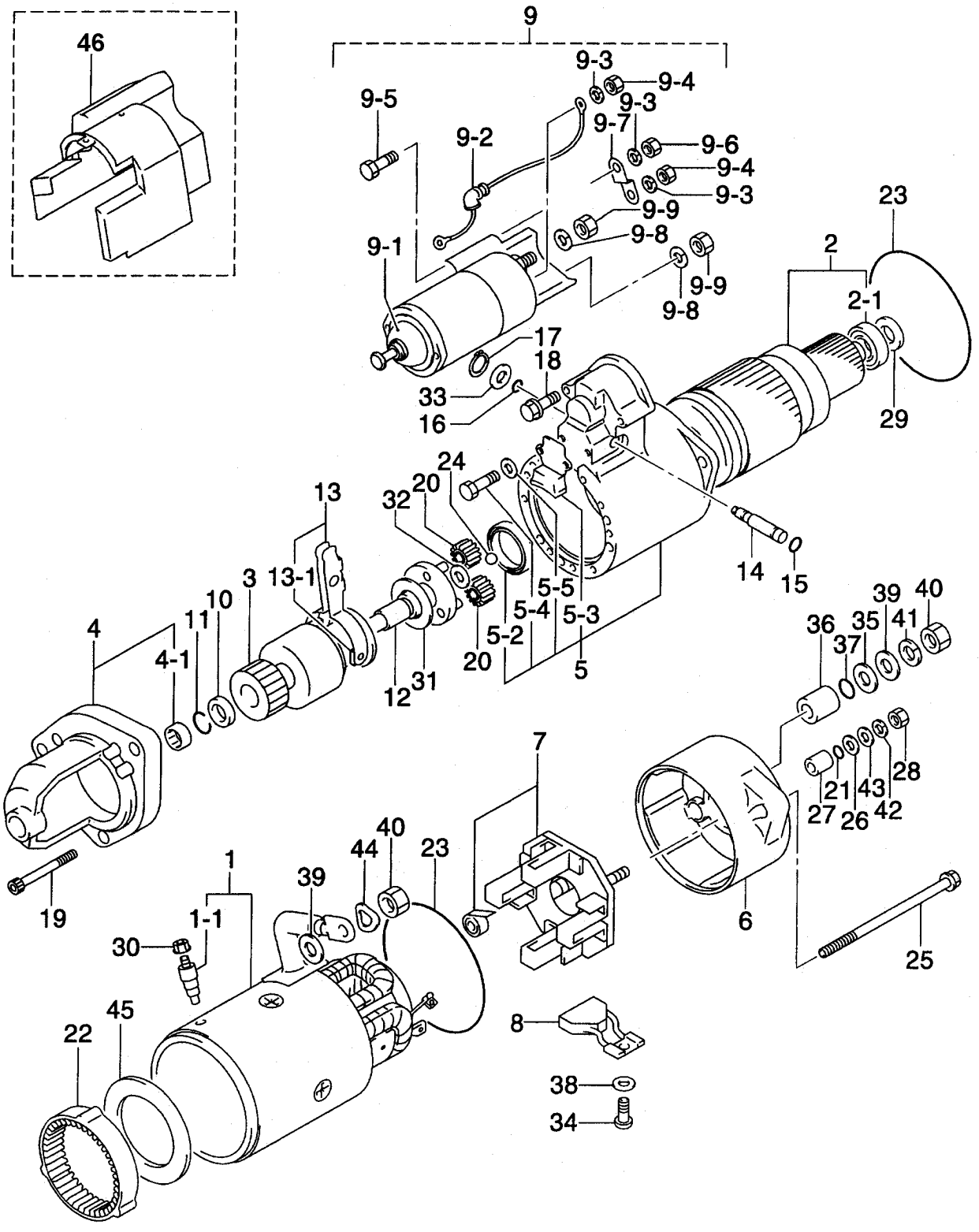


RG12550 –UN–06AUG02

Inspect for Damage

OUOD006,0000045 –19–05JUL02–11/11

John Deere/Denso Planetary Starter Motor Exploded View



Starter Motor Components (12 Volt Model Illustrated)

Continued on next page

OUOD006,000004D –19–08JUL02–1/2

1—Yoke Assembly
1-1—Terminal
2—Armature Assembly
2-1—Bearing
3—Overrunning Clutch
4—Drive End Housing Assembly
4-1—Needle Bearing
5—Center Bearing Assembly
5-1—Bearing (Not shown)
5-2—Seal
5-3—Gasket
5-4—Bolt (2 used)
5-5—Washer (2 used)
6—Frame Assembly
7—Brush Holder Assembly
8—Brush (4 used)
9—Solenoid Switch Assembly
9-1—Plunger Cover
9-2—Connecting Wire
9-3—Lock Washer, M5 (4 used)
9-4—Nut, M5 (3 used)
9-5—Bolt
9-6—Nut, U4.83
9-7—Terminal
9-8—Lock Washer (2 used)
9-9—Nut (2 used)
10—Pinion Stop Collar
11—Snap Ring
12—Planetary Shaft
13—Shift Lever Assembly
13-1—Shift Lever Ring (2 used)
14—Shift Lever Pin
15—O-Ring
16—O-Ring
17—Snap Ring
18—Bolt, M6x40.5 (2 used)
19—Bolt, M7x26.5 (6 used)
20—Planetary Gear (3 used)
21—Seal
22—Internal Gear
23—O-Ring (ID 105) (2 used)
24—Ball
25—Bolt (2 used)
26—Fiber Washer
27—Nonferrous Metal Bushing
28—Nut
29—Washer (Thrust)
30—Nut, M5
31—Washer
32—Washer
33—Washer
34—Brush Screw (4 used)
35—Fiber Washer
36—Nonferrous Metal Bushing
37—O-Ring (ID12.3)
38—Washer (4 used)
39—Flat Washer
40—Nut, U12.7 (2 Used)
41—Lock Washer
42—Lock Washer
43—Flat Washer
44—Wave Washer
45—Seal
46—Terminal Insulation Cover

65
20
15

OUOD006,000004D –19–08JUL02–2/2

Clean Starter Motor Components

IMPORTANT: Do not immerse the solenoid, field windings, or armature in cleaning solvent because it may damage the insulation.

1. Clean parts by wiping with a cloth or brush, moistened with mineral spirits.
2. Dry with compressed air.
3. Clean the drive end housing, overrunning clutch, center bearing housing, and commutator end frame the same way.

   All other parts which are not made of rubber or mentioned previously, can be dipped in cleaning solvent to remove all oil and dirt.

RG,RG34710,2301 –19–15MAR97–1/1

Inspect and Repair Brushes

Replace brushes if they are oil soaked, worn, damaged, or worn beyond specification.

Specification	
New Brush—Length	26 mm (1.02 in.)
Used Brush—Minimum Length	18 mm (0.71 in.)

If brushes are burned or rough, use 00 sandpaper to clean commutator contact area of brushes. Never use emery cloth. Clean all dust from brush before reassembly.

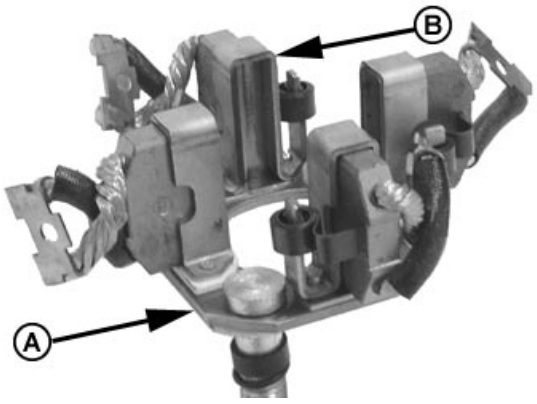
OUOD006,000004E –19–08JUL02–1/1

Test Brush Holder for Grounds

1. Set ohmmeter on its highest scale.
2. Place one test lead on commutator end frame (A). Place other lead on positive brush holder (B).

   If needle swings toward zero, the positive brush holder is grounded and should be replaced.

A—Commutator End Frame
B—Brush Holder



RG12487 –UN–05JUL02

Test Brush Holder for Grounds

OUOD006,0000046 –19–08JUL02–1/1

Measure Brush Spring Tension

Measure spring tension at end of brush spring (A) with a spring scale.

Brush spring tension should be specified just as the spring leaves the brush holder.

Specification

Brush Spring—Minimum Tension..... 26.5 N (6.0 lb-force)

When measuring tension, scale should be parallel with edge of brush holder.

A—Brush Spring

RG12488 –UN–05JUL02

Measure Brush Spring Tension

65
20
17

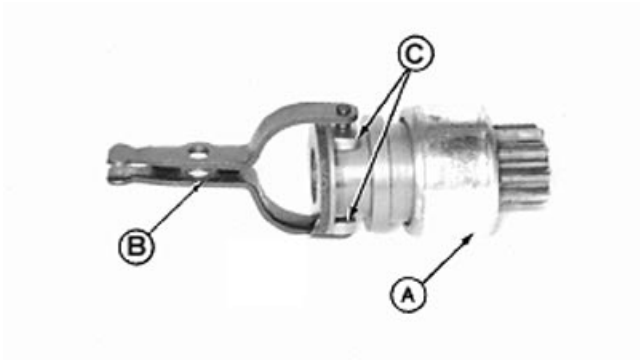
OUOD006,0000047 –19–08JUL02–1/1

Assemble Starter Motor

1. Lubricate both ends of shift lever (B), wear pads (C) on overrunning clutch (A), with a multi-purpose lubricant.

NOTE: Avoid excessive lubrication.

A—Overrunning Clutch
B—Shift Lever
C—Wear Pads



RG12550 –UN–06AUG02

Assemble Starter Motor

OUOD006,0000048 –19–08JUL02–1/9

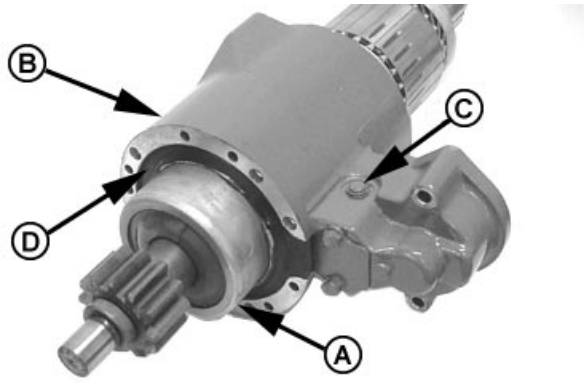
2. Place shift lever and overrunning clutch (A) up into center bearing housing (B).

NOTE: Do not expand snap ring more than 8 mm (0.3 in.) during shift lever pivot installation.

3. Install shift lever pivot (C) with snap ring.

4. Lubricate bearing in center bearing housing generously, but not excessively, with Moribten Grease 7129 or equivalent.

5. Inspect black dust seal (D) around clutch barrel.



RG12489 –UN–05JUL02

Install and Inspect

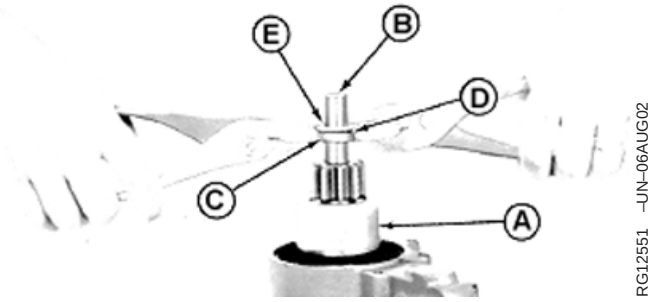
A—Overrunning Clutch
B—Center Bearing Housing
C—Shift Lever Pivot
D—Dust Seal

Continued on next page

OUOD006,0000048 –19–08JUL02–2/9

6. Carefully install armature into center housing.
7. Place center bearing housing with overrunning clutch assembly (A) onto armature shaft (B) and field frame.

   Make sure O-ring in center bearing housing is not twisted or crimped when placed against field frame.
8. Slide pinion stop (C) over retaining ring (D) using a washer (E) and two pair of pliers.
9. Remove washer.



RG12551 –UN–06AUG02

Install Center Housing

A—Overrunning Clutch Assembly
B—Armature Shaft
C—Pinion Stop
D—Retaining Ring
E—Washer (remove after using)

65
20
18

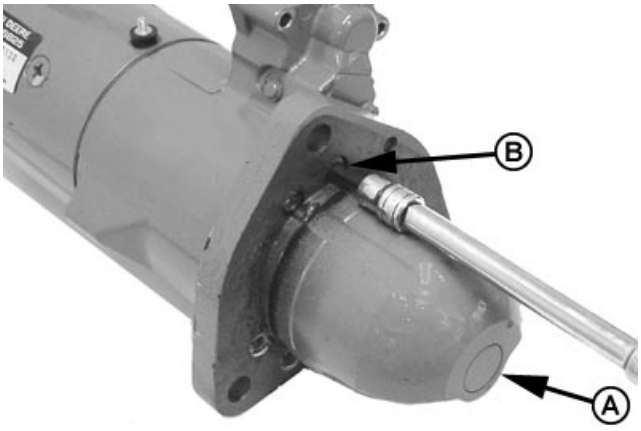
OUOD006,0000048 –19–08JUL02–3/9

10. Align marks made during disassembly and install drive end housing (A) against center bearing housing using hex head bolts (B).
11. Tighten drive end hex head bolts (B) to specifications.

Specification

Drive End Housing-to-Center Housing Cap Screws—Torque..... 17.6—25.4 N•m (13.0—18.7 lb-ft)

A—Drive End Housing
B—Hex Head Bolts



RG12491 –UN–08JUL02

Install Drive End Housing

Continued on next page

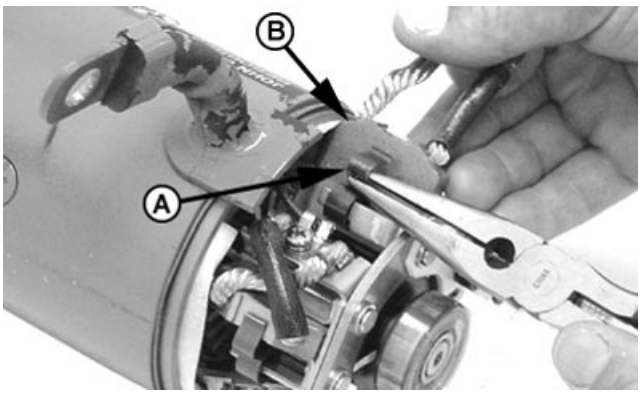
OUOD006,0000048 –19–08JUL02–4/9

12. Place commutator end frame over armature.

NOTE: Be sure commutator end frame notches fit correctly in field frame.

13. Raise brush springs (A) and install brushes (B).

A—Brush Springs (4 used)
B—Brushes (4 used)



Install Brushes

65
20
19

OUOD006,0000048 –19–08JUL02–5/9

14. Twist brush screws 180 degrees so they cross as shown.

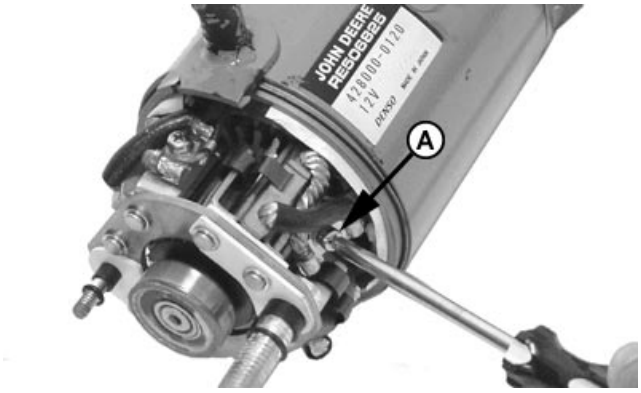
15. Press brush into brush holder so brush spring is fully seated on top of brush.

16. Install brush lead screws (A) and tighten to specifications.

NOTE: Make sure field winding lead and shunt winding leads are tightened down with the brush lead screws.

Specification

Brush Lead Screws—Torque ..... 2.2—3.4 N•m (19.4—30.1 lb-in.)



Install Brush Lead Screws

A—Brush Lead Screw (4 used)

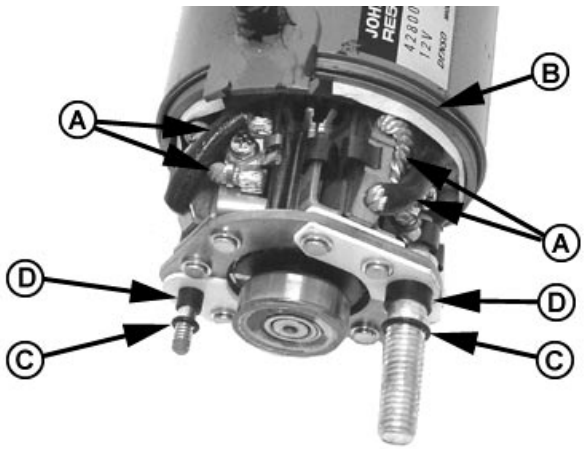
Continued on next page

OUOD006,0000048 –19–08JUL02–6/9

17. Before rear cover installation, verify brush leads (A) are installed as illustrated.

18. Check that rear cover O-ring (B), and stud O-rings (C) and bushings (D) are in good condition and are properly installed.

A—Brush Leads
B—Rear Cover O-Ring
C—Stud O-Rings
D—Stud Bushings



RG12490 –UN–06AUG02

Before Cover Installation

OUOD006,0000048 –19–08JUL02–7/9

65
20
20

19. Install thrust washer (A) in rear end frame.

A—Thrust Washer

RG12552 –UN–07AUG02

Thrust Washer

Continued on next page

OUOD006,0000048 –19–08JUL02–8/9

20. Place rear end frame cover onto field frame.

21. Fasten end frame cover with two bolts (E). Tighten to specifications.

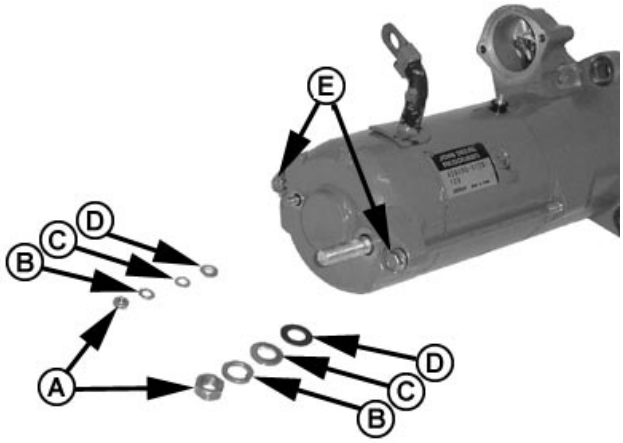
Specification

Rear End Frame Cover to Field
Frame Bolts (M8)—Torque..... 26.5—29.4 N•m (19.5—21.7 lb-ft)

22. Install fiber washers (D) on brush holder assembly studs, followed by flat washers (C) and lock washers (B). Tighten nuts (A) to specifications.

Specification

Brush Holder Assy to Rear Cover
Nut (Ground Terminal) (1/2 in.)—
Torque ..... 27.5—33.3 N•m (20.3—24.5 lb-ft)
Brush Holder Assy to Rear Cover
Nut (1/4 in.)—Torque..... 3.2—4.4 N•m (28.3—38.9 lb-in.)



RG12482 –UN–05JUL02

Rear End Frame Cover

A—Nuts
B—Lock Washers
C—Flat Washers
D—Fiber Washers
E—Bolt (2 used)

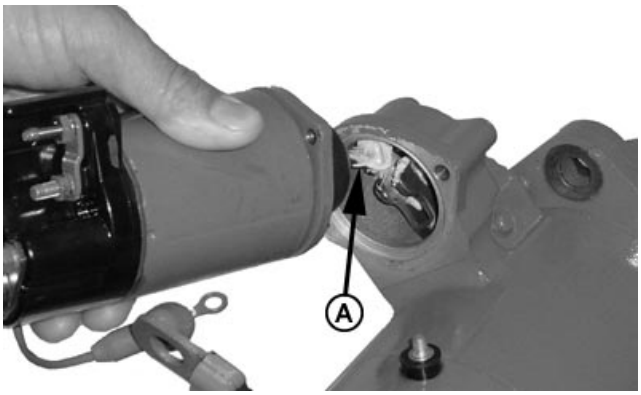
65
20
21

OUOD006,0000048 –19–08JUL02–9/9

Install Solenoid

1. Install solenoid plunger shaft (A) up onto shift lever.

A—Solenoid Plunger Shaft



RG12480 –UN–05JUL02

Solenoid Plunger Shaft

Continued on next page

OUOD006,0000049 –19–08JUL02–1/4

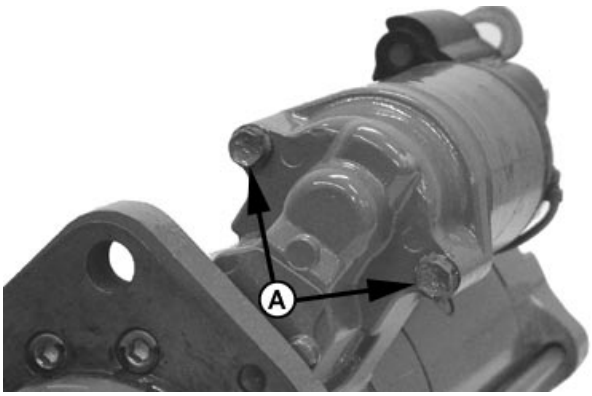
2. Push solenoid assembly forward up against center bearing housing.

3. Attach solenoid with solenoid cap screws (A). Tighten to specifications.

Specification

Solenoid Cap Screws—Torque ..... 10.5—14.5 N•m (7.7—10.7 lb-ft)

A—Solenoid Cap Screws



RG12479 –UN–05JUL02

Solenoid Cap Screws

65
20
22

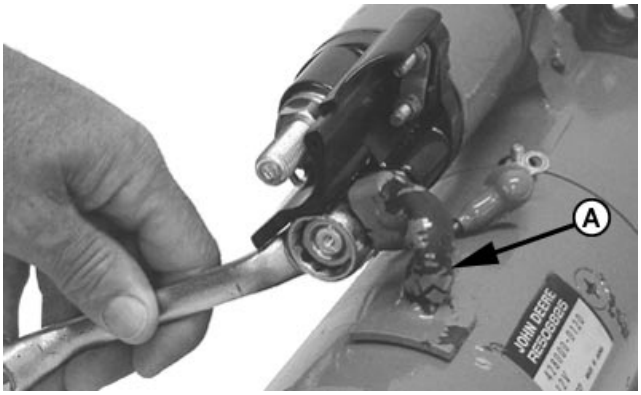
OUOD006,0000049 –19–08JUL02–2/4

4. Install field coil connector (A). Tighten motor (“M”) terminal nut to specifications.

Specification

Motor (“M”) Terminal Nut—
Torque ..... 19.6—29.4 N•m (14.4—21.7 lb-ft)

A—Field Coil Connector



RG12478 –UN–05JUL02

Install Field Coil Connector

Continued on next page

OUOD006,0000049 –19–08JUL02–3/4

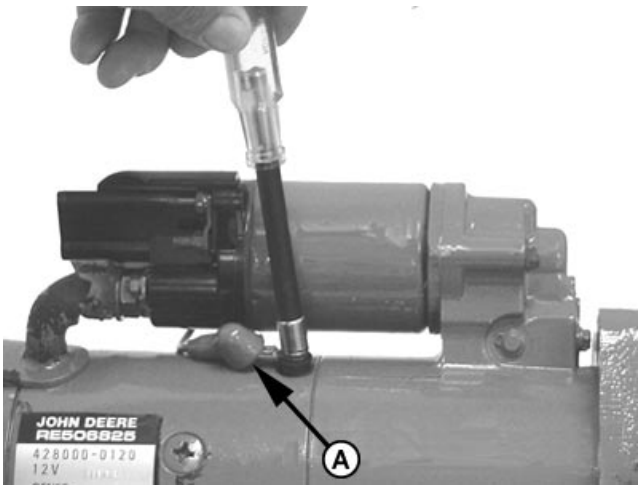
5. Install shunt lead (A). Tighten nut to specifications.

Specification

Shunt Field Lead Nut (Yoke) (M5)—Torque ..... 2.94—4.71 N•m (26.0—41.6 lb-in.)

6. Install terminal cover on solenoid. (Not shown).

A—Shunt Lead



RG12477 –UN–05JUL02

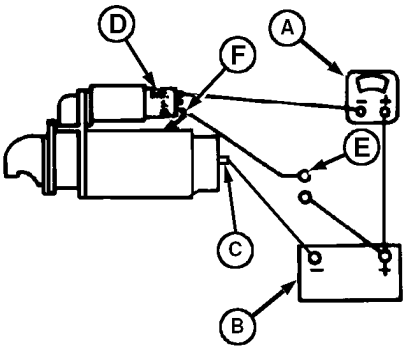
Install Shunt Lead

65
20
23

OUOD006,0000049 –19–08JUL02–4/4

Make No-Load Test

1. Fasten starter in a vise and, using ammeter (A) (capable of measuring several hundred amps), connect the positive lead of battery (B) to plus (+) terminal of ammeter.
2. Connect ammeter negative (-) terminal to solenoid's "B" (battery) terminal (D). Also connect "50" terminal (F) through switch (E) to positive lead of battery.
3. Connect battery negative (-) lead to ground terminal (C).
   Starter should show smooth and steady rotation immediately after pinion jumps out, and should draw less than specified current. (Refer to "Test Specifications" at beginning of this group.)



RG12549 –UN–20AUG02

Make Connections

A—Ammeter
B—Battery
C—Ground Terminal
D—"B" (Battery) Terminal
E—Switch
F—"50" Terminal

RG,RG34710,2297 –19–20AUG02–1/1

Section 70
Bosch Starter Motors

Contents

General Information

IMPORTANT: Never operate starter motor longer than 30 seconds. Allow at least 2 minutes for cooling and battery recovery before operating again. Overheating caused by excessive operation will seriously damage starter motor.

RG,RG34710,2335 –19–15MAR97–1/1

Typical Starting Circuit Operation

When wire from relay (A) is energized, current flows through both pull-in winding (C) and hold-in winding (D) to ground.

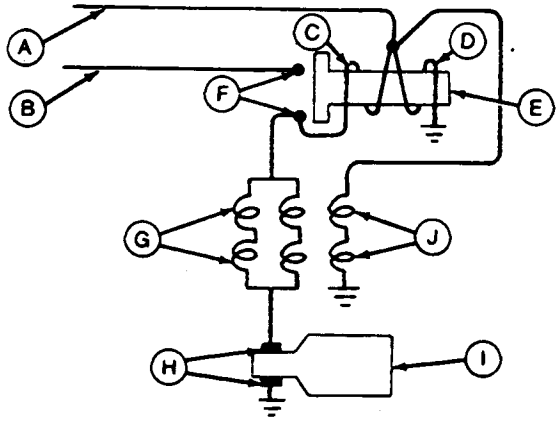
Current through windings engages solenoid plunger (E), which closes main contacts (F). When main contacts close, current through pull-in windings stops. Current continues through hold-in winding, keeping solenoid engaged and main contacts closed.

With main contacts closed, current flows from battery cable (B) to starter motor at a very high rate. Four heavy field windings (G) carry current to commutator brushes (H).

Light shunt windings (J) are wrapped together with two of the heavy field windings. Shunt windings are connected to solenoid switch terminal and directly to ground. They provide additional low-speed torque to assist engine rotation and prevent overspeeding of motor.

From field windings, current flows through armature windings (I) to ground, making contact through commutator brushes (H).

Strong magnetic fields are set up by current flow through field windings and armature windings. Windings are arranged so that magnetic fields constantly repel each other, rotating armature.



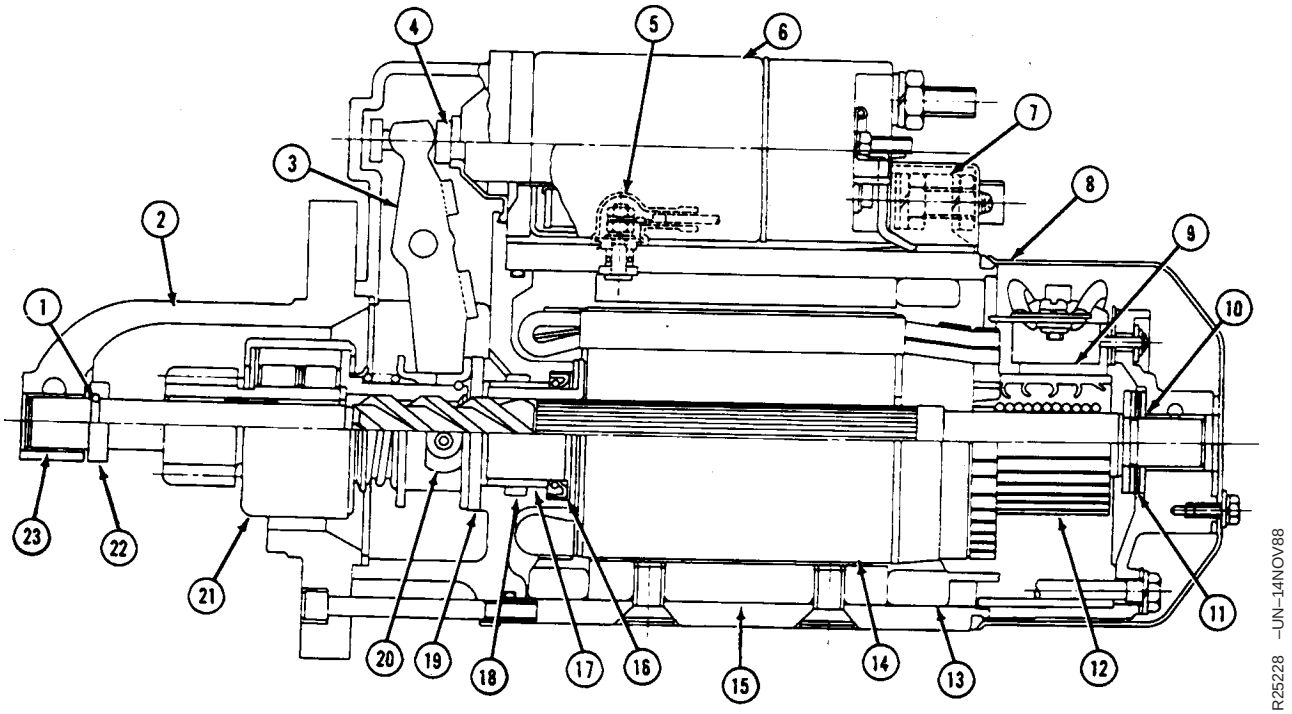
RG1313 –UN–20APR89

Typical Starting Circuit

A—Wire From Relay
B—Cable from Battery
C—Pull-In Winding
D—Hold-In Winding
E—Solenoid Plunger
F—Main Contacts
G—Field Windings
H—Commutator Brushes
I—Armature
J—Shunt Windings

RG,RG34710,2336 –19–15MAR97–1/1

Typical Starter Motor Operation



Typical Starter Motor Operation

1—Snap Ring
2—Drive End Housing
3—Shift Lever
4—Plunger
5—Shunt Field Terminal
6—Solenoid Assembly
7—Field Connector
8—End Frame Cover
9—Brush
10—Bushing
11—Thrust Washer
12—Commutator
13—Field Windings
14—Armature
15—Pole Shoe
16—Oil Seal
17—Bushing
18—Felt
19—Brake Washer
20—Wear Pads
21—Overrunning Clutch
22—Pinion Stop
23—Bushing

When solenoid (6) engages, it pulls shift lever (3). Shift lever pushes overrunning clutch drive (21) to engage pinion in starter gear on flywheel. As armature (14) turns, it cranks engine.

When engine starts, overrunning clutch spins freely on shaft. This prevents overspeeding of armature by flywheel.

When key switch is released, current to solenoid hold-in winding is shut off. Current can feed through both pull-in and hold-in windings from main contacts, but direction of current is reversed in pull-in winding.

The two windings cancel each other, and solenoid is released.

A spring pushes solenoid back to disengaged position. This opens main contacts and shuts off current to field windings and armature.

Shift lever retracts overrunning clutch drive, disengaging pinion from flywheel. Brake washer (19) slows armature to a stop.

The main difference between a conventional starter (illustrated above) and a planetary gear reduction starter is the addition of a planetary gear system between the field frame and the drive end housing. The planetary gear system reduces motor speed while proportionally increasing its torque.

RG,RG34710,2337 –19–23JUL02–1/1

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000BA3 –19–08MAY02–1/3

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUO1004,0000BA3 –19–08MAY02–2/3

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000BA3 –19–08MAY02–3/3

Bosch Conventional Starter Motor Repair Specifications

Item	Measurement	Specification
Commutator (3.0 and 3.1 kW)	Minimum OD	42.5 mm (1.67 in.)
Commutator (2.7 kW)	Minimum OD	39.5 mm (1.555 in.)
Commutator	Insulation Undercut after Turning Down	0.5—0.8 mm (0.02—0.03 in.)
Commutator	Maximum Out-of-Round	0.03 mm (0.0012 in.)
Armature Plate Stacks	Maximum Out-of-Round	0.05 mm (0.002 in.)
Brushes	Minimum Length	7.5 mm (0.30 in.)
Armature	End Play	0.1—0.3 mm (0.004—0.012 in.)
Armature (2.7 kW)	Braking Torque Overrunning Torque	0.45—0.75 N•m (4.0—6.6 lb-in.) 0.40—0.55 N•m (3.5—4.8 lb-in.)
Armature (3.0 and 3.1 kW)	Braking Torque Overrunning Torque	0.5—1.2 N•m (4.42—10.62 lb-in.) 0.35—0.65 N•m (3.10—5.75 lb-in.)

OUO1004,0000BA6 –19–23JUL02–1/1

Bosch Conventional Starter Motor Test Specifications

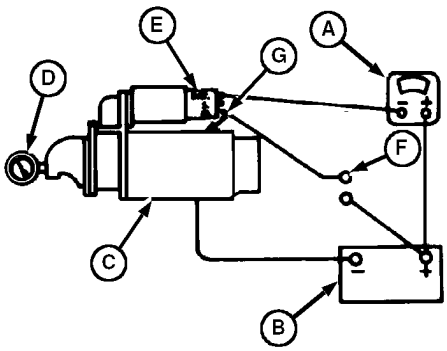
				No Load Test		
John Deere Starter Motor Part No.	**Bosch Starter Motor Model No.**	**System Voltage**	**Rating kW**	**Motor Voltage**	**Amps (Max.)**	**RPM**
AL110503	0 001 367 078	12	3.0	11.5	130	7000
AL110504	0 001 369 022	12	3.1	11.5	170	8000
AL39700	0 001 369 001	12	3.1	9.0 Min	205	9400
AL41247	0 001 362 312	12	2.7	11.5	125	7000
AL62690	0 001 362 316	12	2.7	11.5	125	7000
AL62772	0 001 369 005	12	3.1	11.5	170	8000
AL78760	0 001 367 075	12	3.0	11.5	130	7000
AL81154	0 001 367 077	12	3.0	11.5	130	7000
AR70436	0 001 359 090	12	3.0	9.0 Min	190	7000
RE30493	0 001 362 324	12	2.7	11.5	125	7000
RE508922	6 004 AK3 014	12	2.2	10.5		
RE526375	0 001 B00 039	12	3.8	11.5	220	9000
RE527400	0 001 B00 039	12	3.8	11.5	220	9000
RE62448	0 001 369 012	12	3.1	11.5	170	8000
RE65169	0 001 369 021	12	3.1	11.5	170	8000

Item	Specification
Minimum voltage of solenoid	8 volts
Testing armature for grounded circuit, voltage	40 volts AC
Testing field coils for grounded circuit, voltage	40 volts AC
Testing field coils for open windings, voltage	6—12 volts DC
Testing brush holder insulation for grounded circuit, voltage	40 volts AC

RG,RG34710,2339 –19–07JUL05–1/1

Make No-Load Test

1. Make connections as shown, and use an ammeter (A) capable of measuring several hundred amps.
2. Measure current draw in amps and compare with specifications given earlier in this group.
3. If speed and current draw are slightly low, connect a voltmeter between motor terminal and frame. Observe voltage during test. Voltage may be reduced because of high current draw on battery.
4. If speed or current draw is significantly different than specified, diagnose problem per chart which follows.



RG11163 –UN–28SEP00

Make Connections

A—Ammeter
B—Battery
C—Starter Frame
D—Tachometer
E—Battery Terminal
F—Switch
G—Field Coil Connector

70
10
4

RG,RG34710,2340 –19–15MAR97–1/1

Diagnosing Starter Motor Malfunctions

Fails to Operate, No Current Draw

Open field circuit (all field windings)

Open armature windings

Defective brush contact with commutator

Open solenoid windings

Defective solenoid contacts

Fails to Operate, High Current Draw

Grounded field windings or armature windings

Seized bearings

Low Speed, Low Current Draw

High internal resistance

Defective brush contact with commutator

Low Speed, High Current Draw

Excessive friction

Shorted armature

Grounded armature or field windings

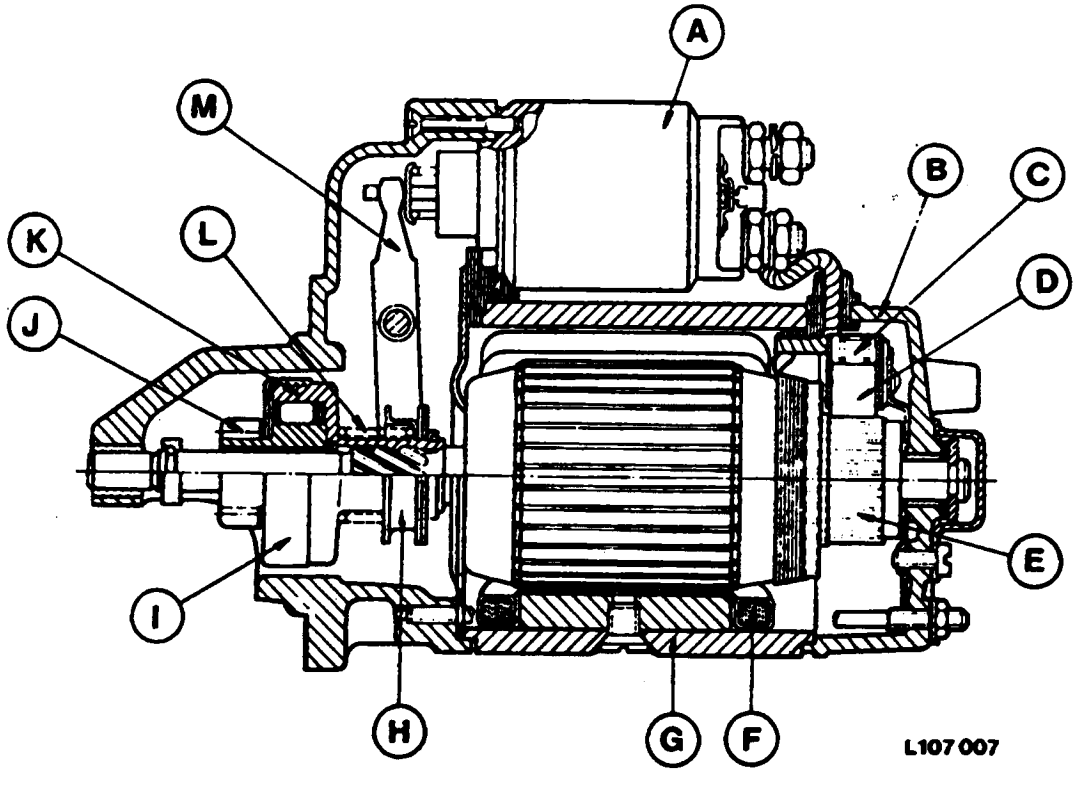
High Speed, High Current Draw

Shorted field windings

NOTE: This test will not detect individual open-circuited field coils—the stator would have a slow cranking speed but would pass this test.

RG,RG34710,2341 –19–15MAR97–1/1

Bosch Conventional Starter Motor Cutaway View

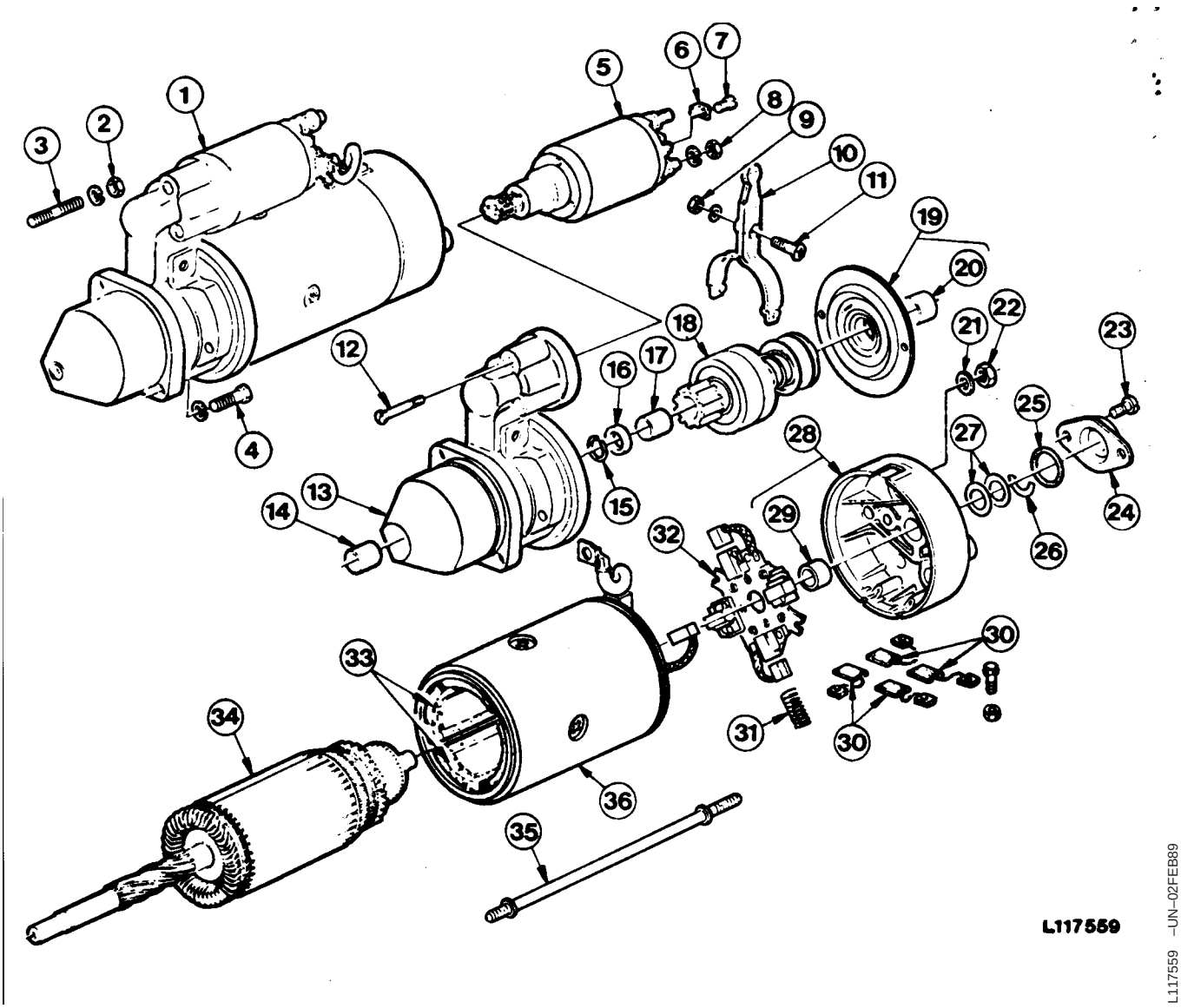


Bosch Conventional Starter Motor

A—Solenoid Switch
B—Commutator End Frame
C—Compression Spring
D—Carbon Brush
E—Commutator
F—Field Winding
G—Field Frame
H—Guide Ring
I—Overrunning Clutch (Roller-Type)
J—Pinion
K—Drive Hub
L—Engaging Spring
M—Engaging Lever

RG,RG34710,2342 –19–23JUL02–1/1

Bosch Conventional Starter Motor Exploded View



L117559 –UN–02FEB89

Conventional Starter Motor—Exploded View

1—Starter Motor Assembly
2—Hex Nut
3—Stud
4—Cap Screw
5—Solenoid Switch
6—Securing Clip
7—Cylinder Head Screw
8—Hex Nuts (4 Used)
9—Hex Nut
10—Engaging Lever
11—Pivot Screw
12—Countersunk Screw (3 Used)
13—Drive End Frame Assembly
14—Bushing
15—Snap Ring
16—Stop Ring
17—Bushing
18—Drive with Pinion
19—Center Bearing
20—Bushing
21—Washer (2 Used)
22—Hex Nut (2 Used)
23—Cylinder Head Screw (2 Used)
24—Cover Cap
25—Rubber Ring
26—Fixing Washer
27—Shims
28—Commutator End Frame
29—Bushing
30—Carbon Brushes (Kit)
31—Compression Spring (4 Used)
32—Carbon Brush Plate
33—Winding
34—Armature
35—Stud (2 Used)
36—Field Frame

RG,RG34710,2343 –19–23JUL02–1/1

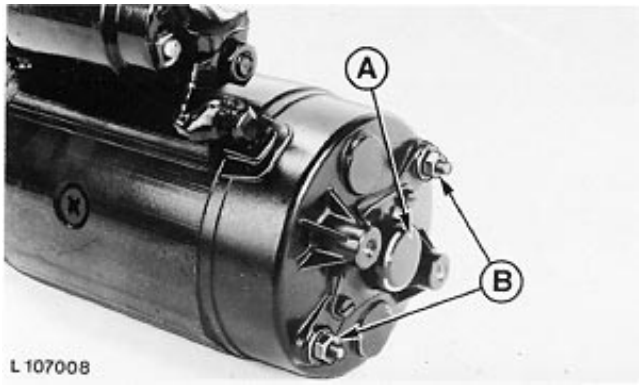
Disassembly

NOTE: Not all parts for Bosch conventional and gear reduction starters are available through John Deere for service. Repair and test procedures provided in the following pages for other components are for reference only.

Unscrew cover cap (A) and remove fixing washer and shims. Be careful with rubber ring.

Remove hex nuts (B).

A—Cover Cap
B—Hex Nuts (2 Used)



L107008 –UN–17JUL89

Unscrew Cover Cap and Remove Hex Nuts

70
10
8

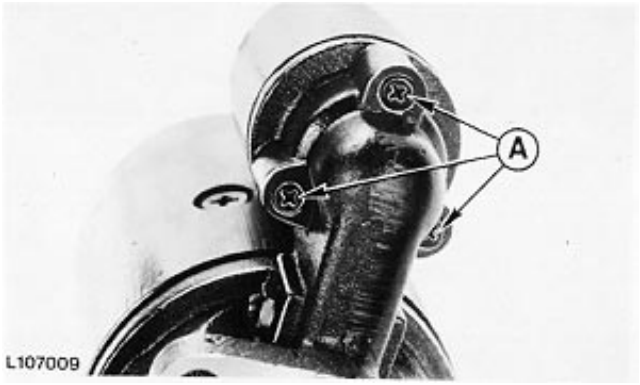
RG,RG34710,2344 –19–26JUN02–1/1

Solenoid Switch—Removal

Disconnect wiring connection from solenoid switch.

Remove attaching screws (A) and pull out solenoid switch with pinion head.

A—Screws (3 Used)



L107009 –UN–17JUL89

Remove Attaching Screws

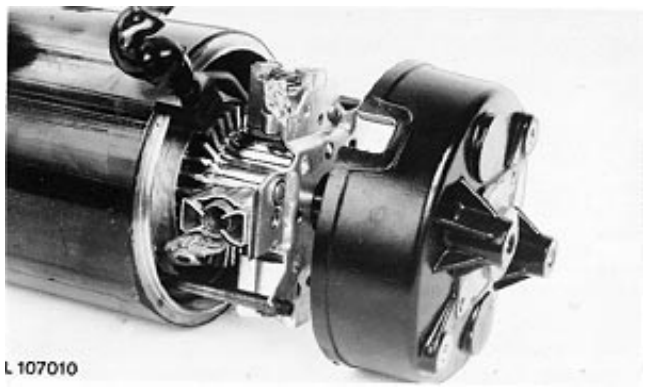
RG,RG34710,2345 –19–15MAR97–1/1

Carbon Brush Plate—Removal

Carefully remove commutator end frame as shown.

NOTE: When removing commutator end frame, the brush compression springs may spring out of the brush holders.

Pull carbon brushes out of carbon brush plate and remove carbon brush plate from armature shaft.



L107010 –UN–17JUL89

Remove Commutator End Frame

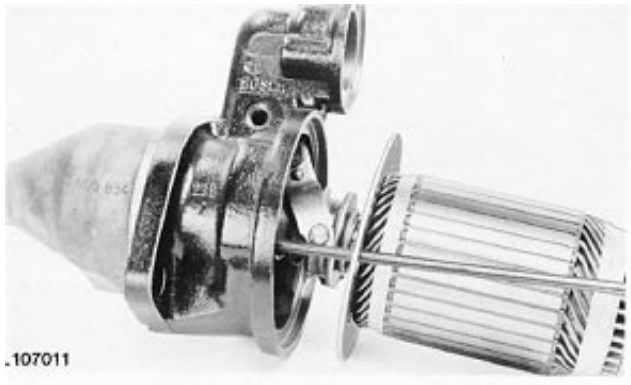
RG,RG34710,2346 –19–15MAR97–1/1

70
10
9

Armature—Removal

Carefully pull armature with drive end frame assembly from field frame (do not damage windings).

Remove engaging lever and armature jointly out of drive end frame assembly.



L107011 –UN–17JUL89

Armature Removal

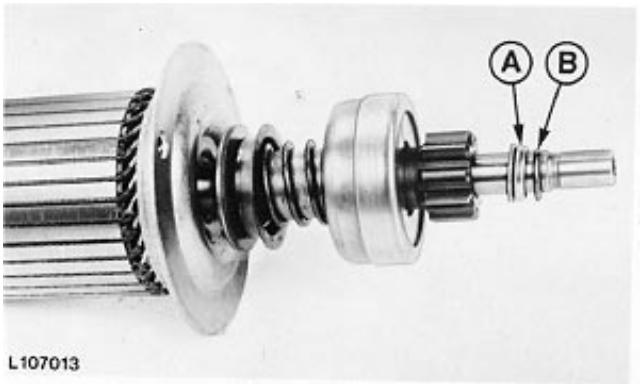
RG,RG34710,2347 –19–15MAR97–1/1

Snap Ring—Removal

Drive back stop ring (A) and bend open snap ring (B).

Remove drive with pinion and center bearing from armature shaft.

A—Stop Ring
B—Snap Ring



L107013 –UN–17JUL89

Snap Ring Removal

RG,RG34710,2348 –19–15MAR97–1/1

70
10
10

Cleaning Parts

Wash parts in solvent and dry with compressed air.

NOTE: Armature, windings and drive with pinion must not be placed in cleaning fluid.

Inspect all parts for wear and mechanical damage.

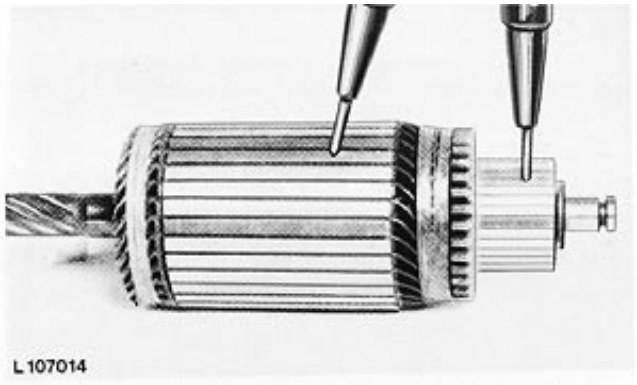
RG,RG34710,2349 –19–15MAR97–1/1

Testing Armature for Grounds

Set ohmmeter to read on highest scale.

Place one test lead on the armature core or shaft. Place other lead on commutator.

If the test meter indicator swings toward zero, the armature is grounded. Replace armature.



L107014 –UN–17JUL89

Test Armature for Grounds

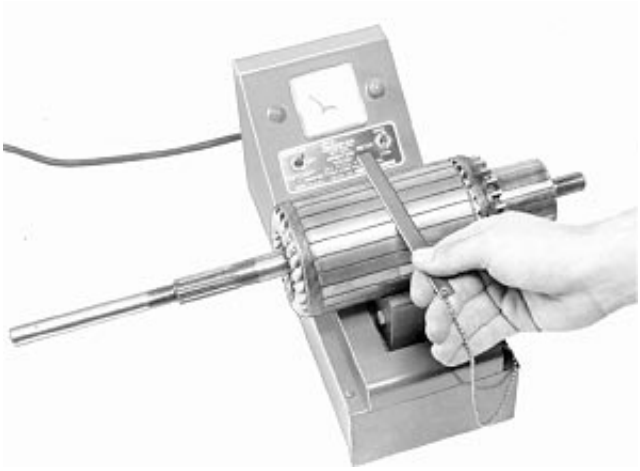
RG,RG34710,2350 –19–15MAR97–1/1

Testing Armature for Short Circuit

Place armature in a growler and hold hacksaw blade above each slot while slowly rotating the armature.

If coil is shorted, the blade will be attracted to and repelled from the slot.

Short circuit most often occurs because of copper dust or filings between two commutator segments. Clean commutator segments to correct this short.



Test Armature for Short Circuit

RG,RG34710,2351 –19–15MAR97–1/1

70
10
11

Testing Armature for Open Circuit

Set ohmmeter to read on lowest scale.

Place one test lead on commutator segment. Place other test lead on an adjacent segment. Repeat this operation for all segments by moving one lead at a time.

If the test meter indicator does not swing to zero and remains stationary, the armature coil between these two segments is open. Replace armature.

RG,RG34710,2352 –19–15MAR97–1/1

Turning Commutator Down

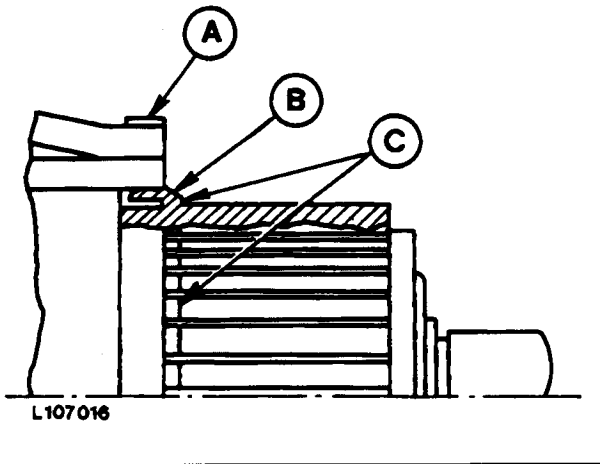
Check commutator OD and compare to specifications.

After turning the commutator down, undercut its insulation to specification with a commutator saw and then finish-turn.

Specification

Commutator (3.0 and 3.1 kW)—Minimum OD	42.5 mm (1.67 in.)
Commutator (2.7 kW)—Minimum OD	39.5 mm (1.555 in.)
Commutator—Insulation Undercut after Turning Down	0.5—0.8 mm (0.02—0.03 in.)

A—Solenoid Lug
B—Claw
C—Turn Down Only to Here



L107016 –UN–06APR89

Turning Commutator Down

70
10
12

RG,RG34710,2353 –19–15MAR97–1/1

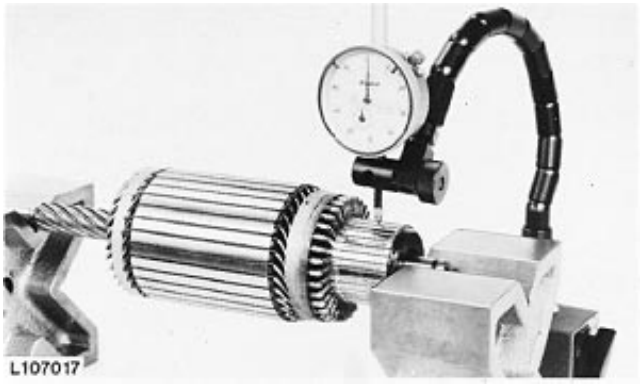
Testing Commutator for Out-of-Roundness

Check commutator out-of-round.

Specification

Commutator—Maximum Out-of-Round	0.03 mm (0.0012 in.)
Armature Plate Stacks—Maximum Out-of-Round	0.05 mm (0.002 in.)

Check armature once again for grounds and short circuits.



L107017 –UN–17JUL89

Test Commutator for Out-of-Roundness

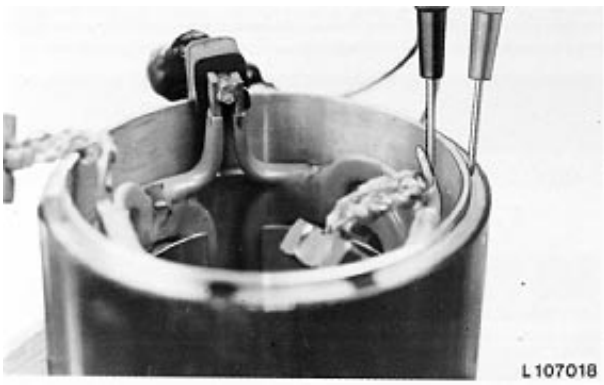
RG,RG34710,2354 –19–15MAR97–1/1

Testing Field Winding for Grounded Circuit

Set ohmmeter to read on highest scale.

Place one test lead on a clean spot on field frame. Place other lead on brush lead.

If the ohmmeter indicator swings toward zero, a grounded circuit is indicated. Replace the field windings.



L107018 –UN–17JUL89

Test Field Winding for Grounded Circuits

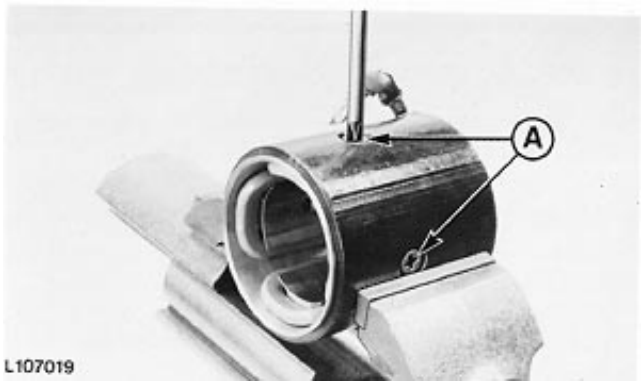
RG,RG34710,2355 –19–15MAR97–1/1

70
10
13

Field Winding—Removal

Mark position of pole shoes and winding ends and unscrew pole shoe screws (A).

A—Pole Shoe Screws



L107019 –UN–17JUL89

Unscrew Pole Shoe Screws

RG,RG34710,2356 –19–15MAR97–1/1

Make Open Circuit Test for Field Windings

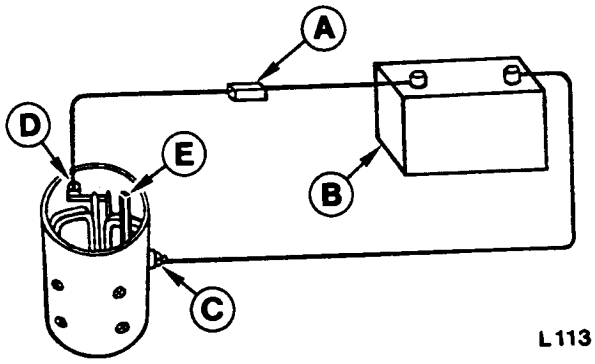
All four field windings are connected in parallel. Test each winding for an open circuit.

Connect a test battery (B) to field terminal (C) and either insulated brush lead (D), using a resistor (A) to limit current draw.

Use a hacksaw blade (E) to test winding for magnetism. If any winding is not magnetic, the winding is open circuited. Repair or replace windings.

NOTE: Because 1/4-ohm resistors capable of carrying several hundred watts are not widely available, a suggested alternative is to connect four 1-ohm resistors in parallel. Each resistor should be rated for at least 150 watts. A carbon pile resistor can also be used. Limit current to 40—70 amps.

There is no suitable way to check field windings for short circuits. Winding resistance is too low to permit detection of a short circuit.



Make Open Circuit Test for Field Windings

A—1/4-Ohm Resistor
B—12-Volt Battery
C—Field Terminal
D—Insulated Brush Lead
E—Hacksaw Blade

70
10
14

RG,RG34710,2357 –19–15MAR97–1/1

Lubrication of Starter Motor (Before and During Assembly)

Lubrication Point	Lubrication Instructions
Bushings	Soak new bushings for at least 1/2 hour before installation.
Armature shaft	Coat drive and commutator end journals of shaft, splines and bearing surfaces of clutch drive with a light film of grease.
Shift Lever	Lubricate bearing surfaces and pivot bolts liberally with grease.
Solenoid switch	Coat inside of yoke and bolt threads with a light film of grease.

NOTE: Keep contacts free from grease.

RG,RG34710,2358 –19–15MAR97–1/1

Field Winding—Installation

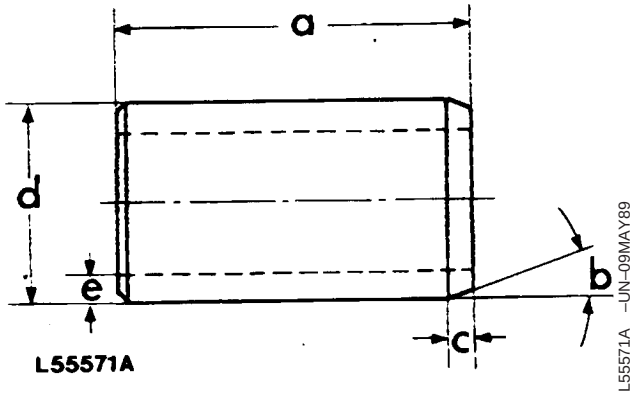
Slightly warm windings and insert together with pole shoes into field frame. Insert pole shoe screws.

Press suitable mandrel (see illustration) between pole shoes.

Firmly tighten pole shoe screws and press out mandrel.

Check installed windings for shorted or open circuits.

a—85 mm (3.35 in.)
b—5° Chamfer
c—12—14 mm (0.47—0.55 in.)
d—75.80—75.85 mm (2.984—2.986 in.)
e—Wall Thickness 12—15 mm (0.47—0.59 in.)



Field Winding Installation

RG,RG34710,2359 –19–15MAR97–1/1

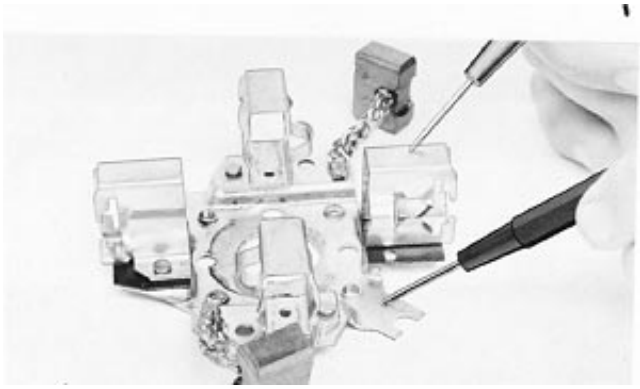
70
10
15

Checking Carbon Brush Plate for Grounds

Set ohmmeter on its highest scale.

Place one test lead on commutator end frame. Place other lead on brush holder.

If needle swings toward zero, the positive brush holder is grounded and should be replaced.



Check Carbon Brush Plate for Grounds

RG,RG34710,2360 –19–15MAR97–1/1

Testing Carbon Brushes

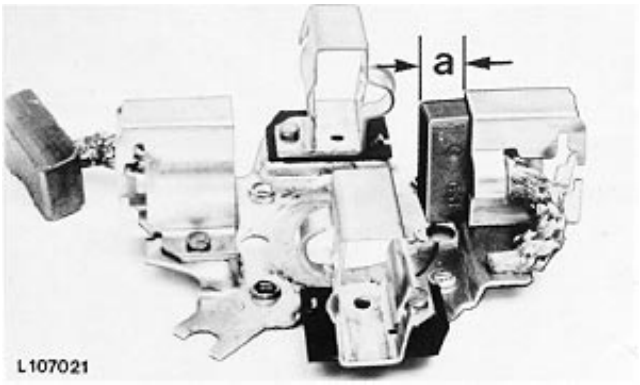
The carbon brushes must move freely in their guides.

Check brush length and compare to specifications.

Specification

Brushes—Minimum Length ..... 7.5 mm (0.30 in.)

a—Brush Length



L107021 –UN–17JUL89

Test Carbon Brushes

RG,RG34710,2361 –19–15MAR97–1/1

70
10
16

Replace Carbon Brushes

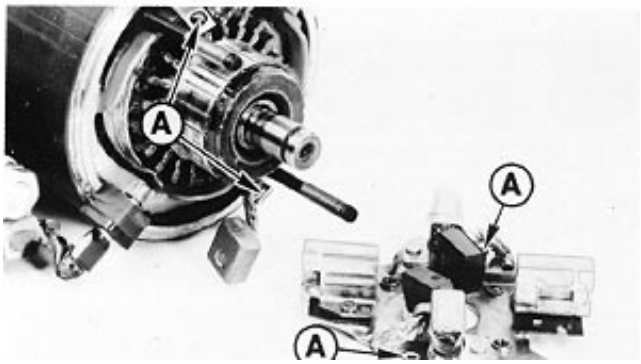
Cut off old brushes at end of brush strands.

Secure new brushes in bores (A).

Check for easy movement of carbon brushes in brush holders.

NOTE: Screws and hex nuts are included in the repair kit.

A—Brush Bores



L117234 –UN–17JUL89

Secure Brushes in Bores

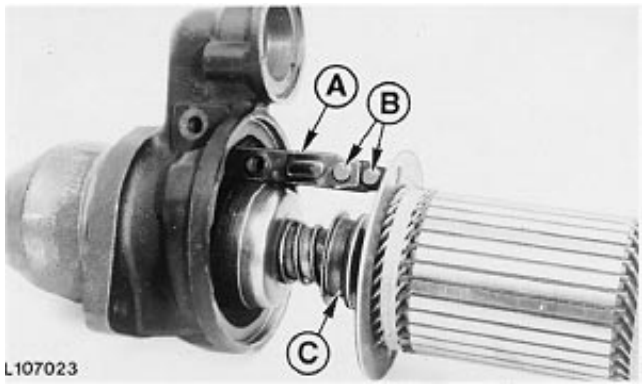
RG,RG34710,2362 –19–15MAR97–1/1

Engaging Lever—Installation

Driving hub pins (B) of engaging lever (A) must engage in guide (C) of drive pinion.

Screw in studs and slide field frame over armature.

A—Engaging Lever
B—Pins
C—Guide



Engaging Lever Installation

RG,RG34710,2363 –19–15MAR97–1/1

70
10
17

Checking Armature End Play and Torque

Check end play of armature using a dial indicator.

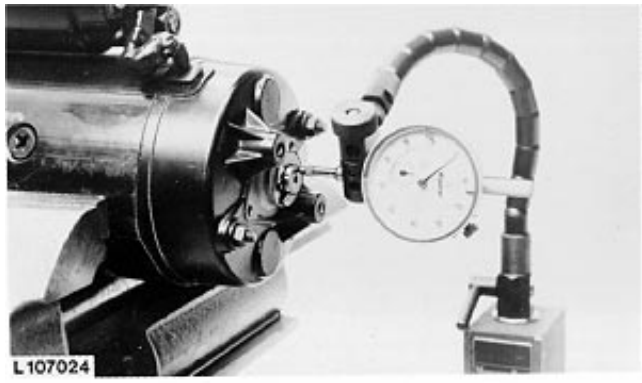
Specification

Armature—End Play	0.1—0.3 mm (0.004—0.012 in.)

Check armature torque.

Specification

Armature (2.7 kW)—Braking Torque	0.45—0.75 N•m (4.0—6.6 lb-in.)
Overrunning Torque	0.40—0.55 N•m (3.5—4.8 lb-in.)
Armature (3.0 and 3.1 kW)—Braking Torque	0.5—1.2 N•m (4.42—10.62 lb-in.)
Overrunning Torque	0.35—0.65 N•m (3.10—5.75 lb-in.)



Test Armature End Play

RG,RG34710,2364 –19–25SEP00–1/1

Installing Starter Motor

Refer to machine technical manual for installing starter motor and adjusting belt tension.

RG,RG34710,2365 –19–15MAR97–1/1

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUOD006,000004F –19–23JUL02–1/3

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUOD006,000004F –19–23JUL02–2/3

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUOD006,000004F –19–23JUL02–3/3

70
15
1

Bosch Planetary Gear Starter Motor Test Specifications

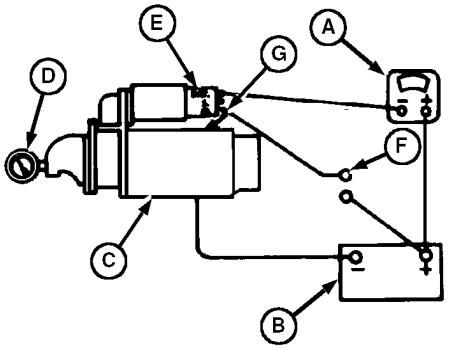
				No Load Test		
John Deere Starter Motor Part No.	Bosch Starter Motor Model No.	System Voltage	Rating kW	Motor Voltage	Amps (Max.)	RPM
RE500819	0 001 230 005	12	3.0	11.4	204	4735—6500
RE501347	0 001 223 502	12	2.6	11.4	142	5300
RE501551	0 001 230 008	12	3.0	11.4	204	4735—6500
RE503226	0 001 230 002	12	3.0	11.4	204	4735—6500
RE506589	0 001 230 003	12	3.0	11.4	204	4735—6500
RE507943	0 001 230 018	12	3.0	11.4	204	4735—6500

70
15
2

OUOD006,0000050 –19–07JUL05–1/1

Make No-Load Test

1. Make connections as shown, and use an ammeter (A) capable of measuring several hundred amps.
2. Measure current draw in amps and compare with specifications given earlier in this group.
3. If speed and current draw are slightly low, connect a voltmeter between motor terminal and frame. Observe voltage during test. Voltage may be reduced because of high current draw on battery.
4. If speed or current draw is significantly different than specified, diagnose problem per chart which follows.



RG11163 –UN–28SEP00

Make Connections

A—Ammeter
B—Battery
C—Starter Frame
D—Tachometer
E—Battery Terminal
F—Switch
G—Field Coil Connector

RG,RG34710,2340 –19–15MAR97–1/1

Diagnosing Starter Motor Malfunctions

Fails to Operate, No Current Draw

Open field circuit (all field windings)

Open armature windings

Defective brush contact with commutator

Open solenoid windings

Defective solenoid contacts

Fails to Operate, High Current Draw

Grounded field windings or armature windings

Seized bearings

Low Speed, Low Current Draw

High internal resistance

Defective brush contact with commutator

Low Speed, High Current Draw

Excessive friction

Shorted armature

Grounded armature or field windings

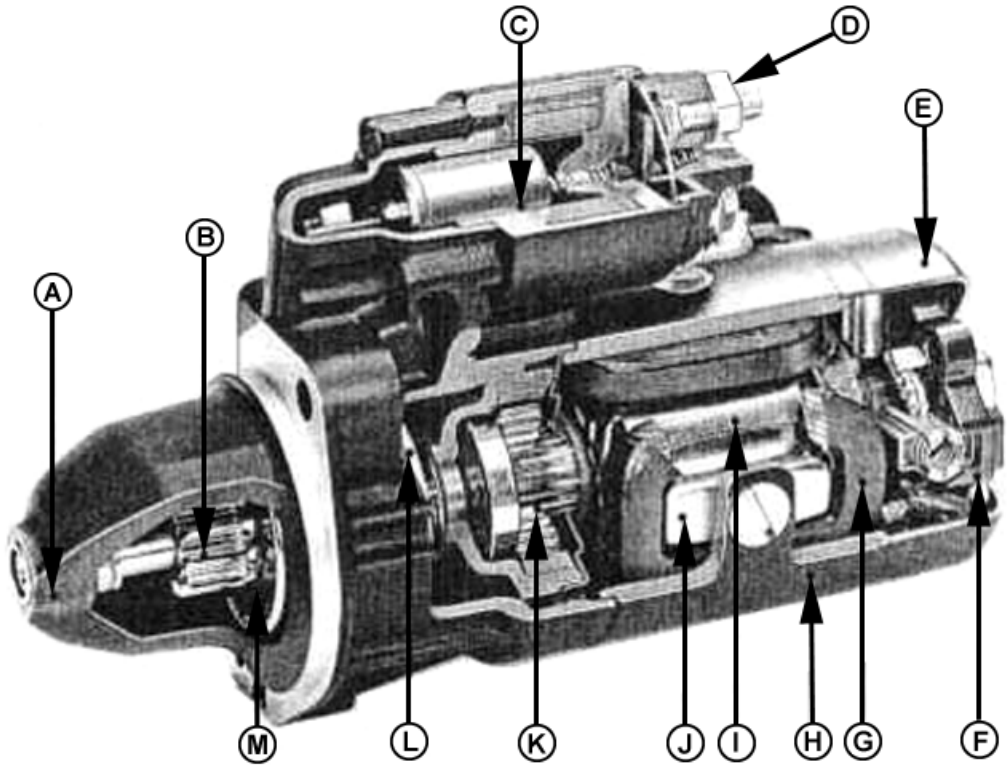
High Speed, High Current Draw

Shorted field windings

NOTE: This test will not detect individual open-circuited field coils—the stator would have a slow cranking speed but would pass this test.

RG,RG34710,2341 –19–15MAR97–1/1

Bosch Planetary Gear Starter Motor Cutaway View



RG12493 –UN–24JUL02

Bosch Planetary Gear Starter Motor

A—Drive End Housing
B—Pinion
C—Solenoid Switch
D—Terminal
E—Commutator End Frame
F—Brush Plate with Carbon Brushes
G—Excitation Winding
H—Field Frame
I—Armature
J—Pole Shoe
K—Planetary Gear
L—Shift Lever
M—Pinion-engaging Drive

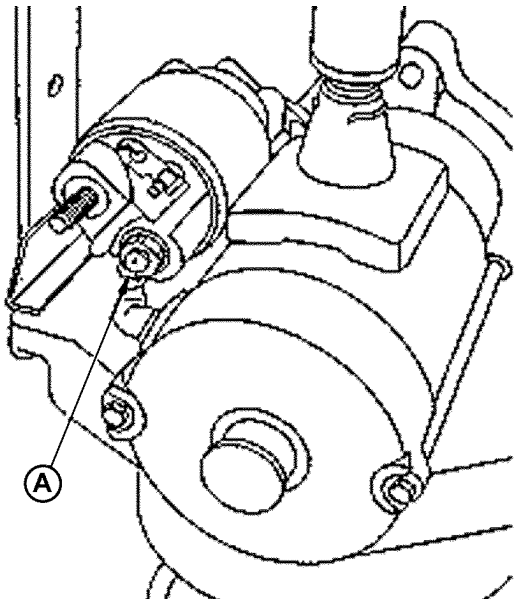
OUOD006,0000051 –19–23JUL02–1/1

Disassemble Solenoid Switch

Clamp starting motor in fixture.

Remove excitation winding connection (A) from solenoid.

A—Excitation Winding Connection



RG12497 –UN–24JUL02

Remove Excitation Winding

OUOD006,0000052 –19–23JUL02–1/3

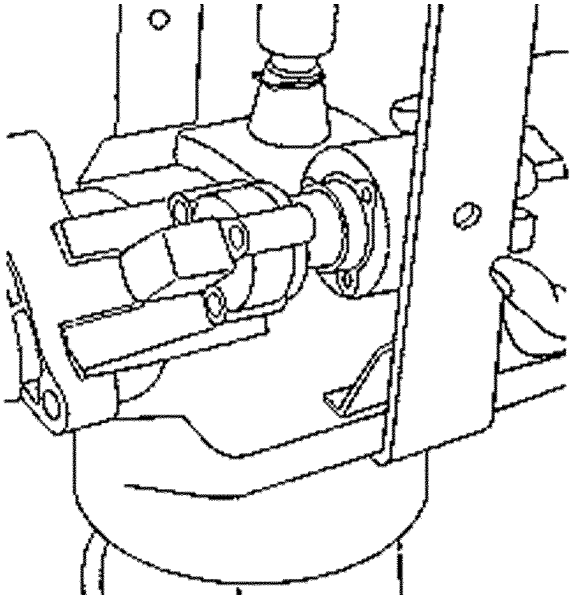
70
15
5

Mark position of solenoid switch.

CAUTION: Return spring is pretensioned, and can cause injury when released.

Remove solenoid switch screws.

Remove solenoid switch from solenoid plunger as illustrated.



RG12498 –UN–24JUL02

Remove Solenoid Switch

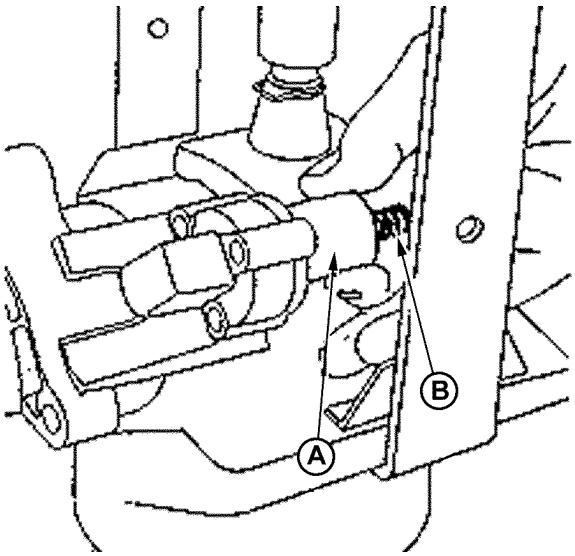
Continued on next page

OUOD006,0000052 –19–23JUL02–2/3

Disengage solenoid plunger (A) at shift lever.

NOTE: Pay attention not to lose or misplace return spring (B) in solenoid plunger.

A—Solenoid Plunger
B—Return Spring



RG12499 –UN–24JUL02

Disengage Solenoid Plunger

70
15
6

OUOD006,0000052 –19–23JUL02–3/3

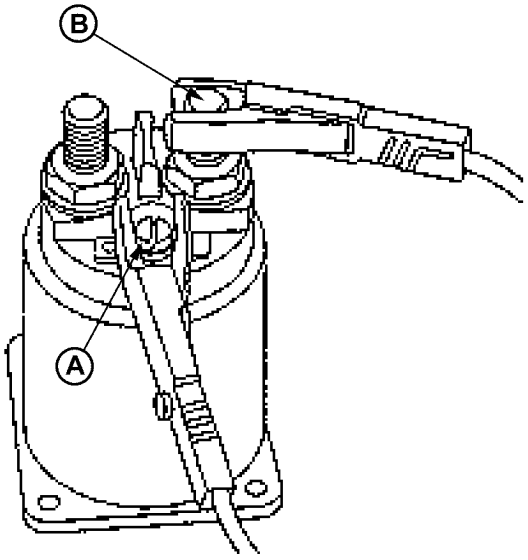
Test Solenoid Switch

Connect tester leads to Terminal 50 (A) and Terminal 30-f (B).

Check resistance of pull-in winding against specification.

Specification	
Pull-in winding—Resistance	0.25—0.30 ohms

A—Terminal 50
B—Terminal 30-f



RG12546 –UN–25JUL02

Check Pull-in Winding

Continued on next page

OUOD006,0000053 –19–24JUL02–1/2

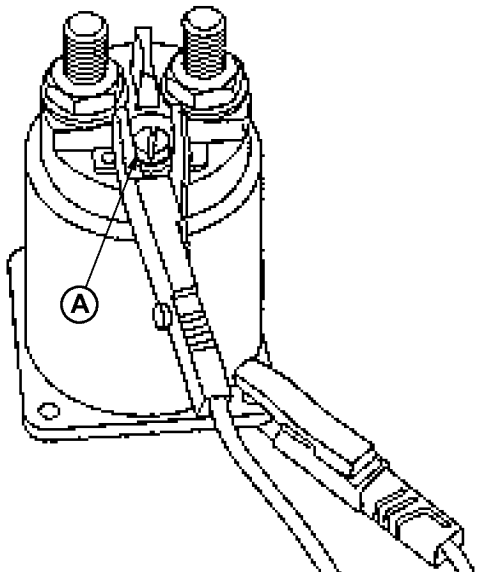
Connect tester leads to Terminal 50 (A) and Ground.

Check resistance of hold-in winding against specification.

Specification

Hold-in winding—Resistance..... 1.1—1.3 ohms

A—Terminal 50



RG12547 –UN–25JUL02

Check Hold-in Winding

OUOD006,0000053 –19–24JUL02–2/2

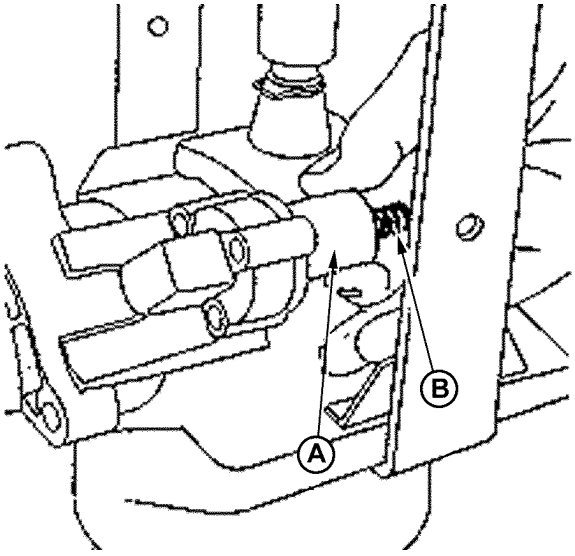
70
15
7

Assemble Solenoid Switch

Press pinion against stop ring, hook solenoid plunger (A) into engaging lever, and grease lightly around periphery.

NOTE: Pay attention not to lose or misplace return spring (B) in solenoid plunger.

A—Solenoid Plunger
B—Return Spring



RG12499 –UN–24JUL02

Assemble Solenoid Switch

Continued on next page

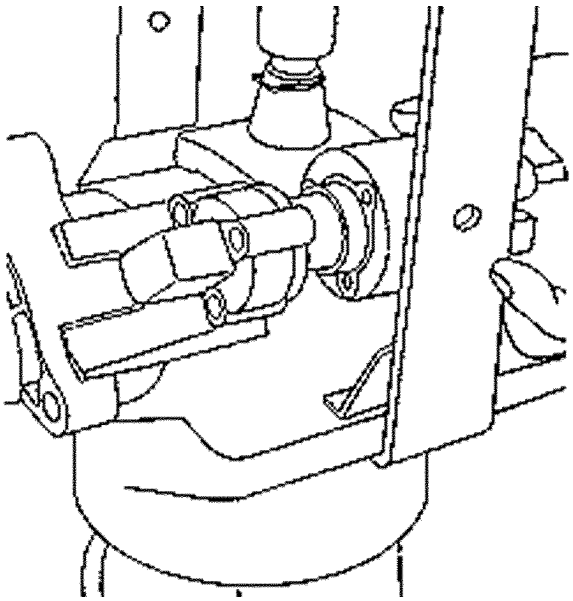
OUOD006,0000054 –19–24JUL02–1/2

Using solenoid position mark made previously, align solenoid switch with drive end bearing housing and fasten with screws.

Torque to specification.

Specification

Solenoid Switch Screws—Torque ..... 4.5—5.5 N•m (40—49 lb-in.)



RG12498 –UN–24JUL02

Attach Solenoid Switch

OUOD006,0000054 –19–24JUL02–2/2

70
15
8

Section 75
Iskra Starter Motors

Contents

General Information

IMPORTANT: Never operate starter motor longer than 30 seconds. Allow at least 2 minutes for cooling and battery recovery before operating again. Overheating caused by excessive operation will seriously damage starter motor.

RG,RG34710,2366 –19–15MAR97–1/1

Typical Starting Circuit Operation

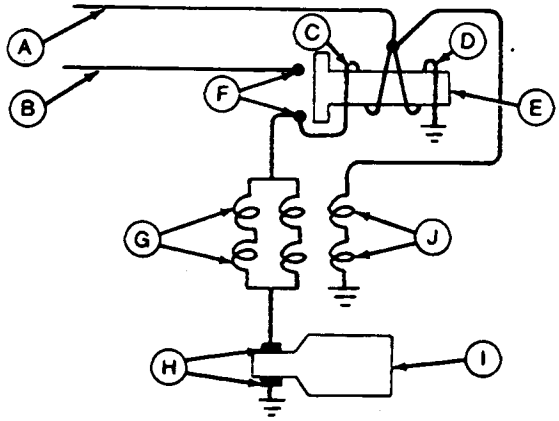
When wire from relay (A) is energized, current flows through both pull-in winding (C) and hold-in winding (D) to ground.

Current through windings engages solenoid plunger (E), which closes main contacts (F). When main contacts close, current through pull-in windings stops. Current continues through hold-in winding, keeping solenoid engaged and main contacts closed.

With main contacts closed, current flows from battery cable (B) to starter motor at a very high rate. Four heavy field windings (G) carry current to commutator brushes (H).

From field windings, current flows through armature windings (I) to ground, making contact through commutator brushes (H).

Strong magnetic fields are set up by current flow through field windings and armature windings. Windings are arranged so that magnetic fields constantly repel each other, rotating armature.



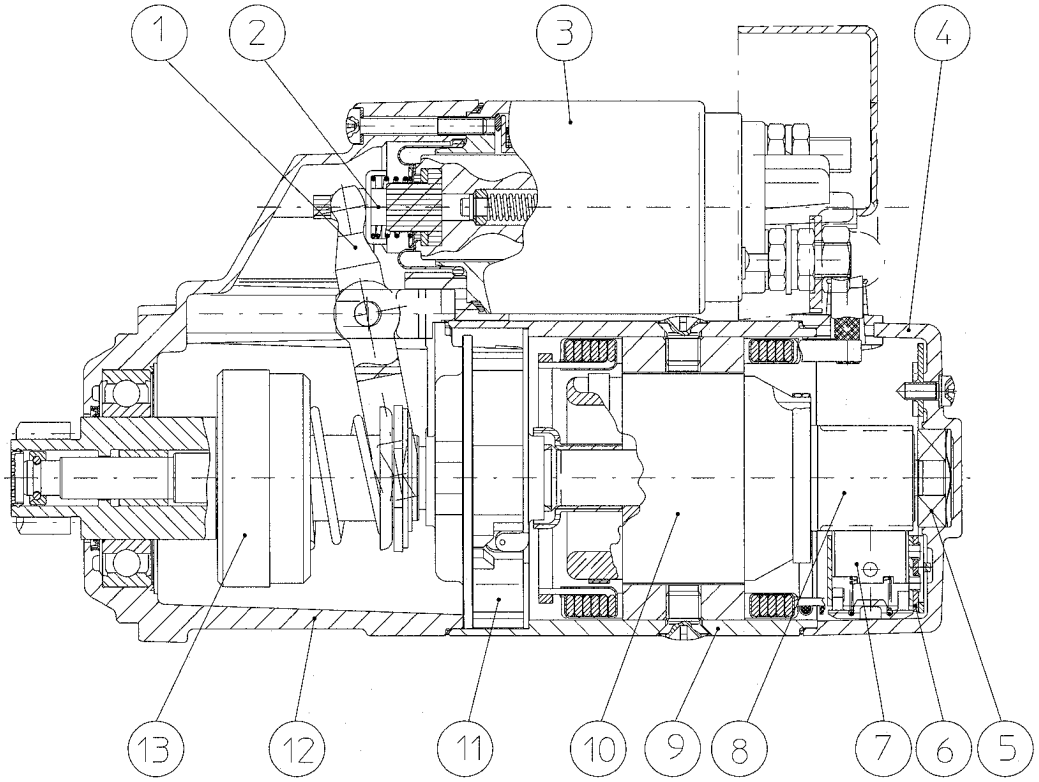
RG1313 –UN–20APR89

Typical Starting Circuit Operation

A—Wire from Relay
B—Cable from Battery
C—Pull-In Winding
D—Hold-Iin Winding
E—Solenoid Plunger
F—Main Contacts
G—Field Windings
H—Commutator Brushes
I—Armature
J—Shunt Windings

RG,RG34710,2367 –19–15MAR97–1/1

Starter Motor Operation



Starter Motor Operation

1—Engaging Lever
2—Plunger
3—Solenoid
4—Commutator End Bracket
5—Bearing
6—Brush Holder
7—Brush Kit
8—Commutator
9—Field Coil
10—Armature
11—Reduction Gear Assembly
12—Drive End Bracket
13—Overrunning Clutch Drive Assembly

When solenoid (3) engages, it pulls engaging lever (1). Engaging lever pushes overrunning clutch drive (13) to engage pinion in starter gear on flywheel. As armature (10) turns, it cranks engine.

When engine starts, overrunning clutch spins freely on shaft. This prevents overspeeding of armature by flywheel.

When key switch is released, current to solenoid hold-in winding is shut off. Current can feed through both pull-in and hold-in windings from main contacts, but direction of current is reversed in pull-in winding. The two windings cancel each other, and solenoid is released.

A spring pushes solenoid back to disengaged position. This opens main contacts and shuts off current to field windings and armature.

Engaging lever retracts overrunning clutch drive, disengaging pinion from flywheel.

RG,RG34710,2368 –19–07MAY02–1/1

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000BA7 –19–08MAY02–1/3

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

75
10
1

OUO1004,0000BA7 –19–08MAY02–2/3

Alternator, Generator, Starter and Battery Bench Tester. JT01760

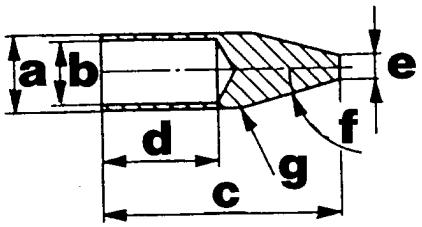
Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000BA7 –19–08MAY02–3/3

Dealer Fabricated Tools

Pilot for Retaining Ring Installation- AZF Type

a—Dia. 15.4 mm (0.606 in.)
b—Dia. 14.4 mm (0.567 in.)
c—50 mm (1.97 in.)
d—18.5 mm (0.728 in.)
e—5 mm (0.20 in.)
f—30°
g—R10 mm (0.39 in.)



CD30492 –UN–31JAN97

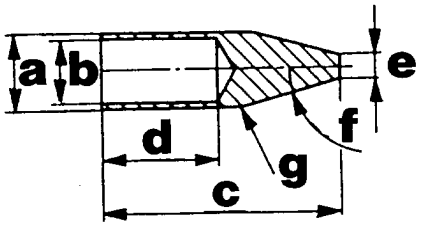
Pilot for Retaining Ring

OUOD006,000005F –19–14AUG02–1/6

Pilot for Retaining Ring Installation- AZJ Type

75
10
2

a—Dia. 15.4—15.5 mm (0.606—0.610 in.)
b—Dia. 14.4—14.5 mm (0.567—0.571 in.)
c—50 mm (1.97 in.)
d—25 mm (0.98 in.)
e—5 mm (0.20 in.)
f—30°
g—R10 mm (0.39 in.)



CD30492 –UN–31JAN97

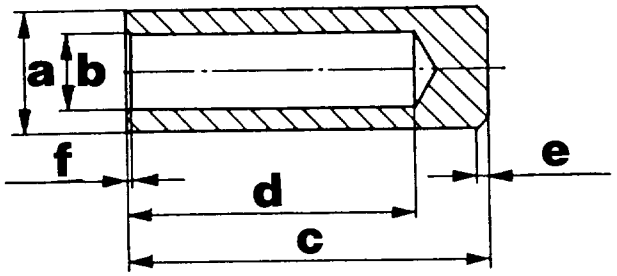
Pilot for Retaining Ring

Continued on next page

OUOD006,000005F –19–14AUG02–2/6

Driver for Retaining Ring Installation and for Pinion Stop Removal- AZF Type

a—Dia. 18.5 mm (0.728 in.)
b—Dia. 15.4 mm (0.606 in.)
c—75 mm (2.95 in.)
d—60 mm (2.36 in.)
e—Chamfer 45° x 2 mm (0.08 in.)
f—Chamfer 45° x 0.5 mm (0.02 in.)



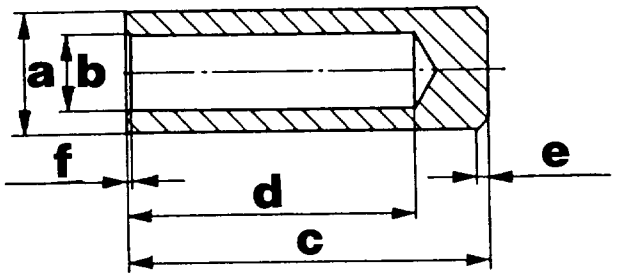
CD30493 –UN–03FEB97

Driver for Retaining Ring and Pinion Stop

OUOD006,000005F –19–14AUG02–3/6

Driver for Retaining Ring Installation and for Pinion Stop Removal- AZJ Type

a—Dia. 25 mm (0.98 in.)
b—Dia. 15.5—15.6 mm (0.610—0.614 in.)
c—75 mm (2.95 in.)
d—60 mm (2.36 in.)
e—Chamfer 45° x 2 mm (0.08 in.)
f—Chamfer 45° x 0.5 mm (0.02 in.)



CD30493 –UN–03FEB97

Driver for Retaining Ring and Pinion Stop

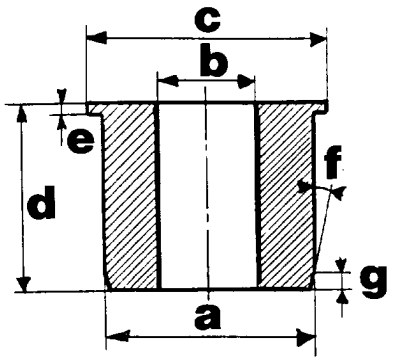
Continued on next page

OUOD006,000005F –19–14AUG02–4/6

Dummy Commutator for Brush Holder Removal and Installation- AZF Type

Material: Plastic

a—Dia. 36 mm (1.42 in.)
b—Dia. 16 mm (0.63 in.)
c—Dia. 40 mm (1.57 in.)
d—35 mm (1.38 in.)
e—2.5 mm (0.10 in.)
f—Chamfer 15°
g—2 mm (0.08 in.)



CD30494 –UN–31JAN97

Dummy Commutator for Brush Holder

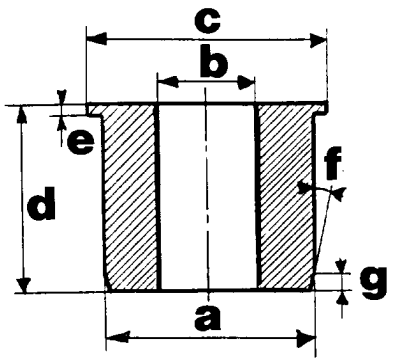
OUOD006,000005F –19–14AUG02–5/6

Dummy Commutator for Brush Holder Removal and Installation-AZJ Type

75
10
4

Material: Plastic

a—Dia. 44.9—45.1 mm (1.768—1.775 in.)
b—Dia. 20 mm (0.79 in.)
c—Dia. 50 mm (1.97 in.)
d—35 mm (1.38 in.)
e—2.5 mm (0.10 in.)
f—Chamfer 15°
g—2.5 mm (0.10 in.)



CD30494 –UN–31JAN97

Dummy Commutator for Brush Holder

OUOD006,000005F –19–14AUG02–6/6

Iskra AZF-Type Starter Motor Repair Specifications

Item	Measurement	Specification
New Brush	Length	19.5 mm (0.77 in.)
Used Brush	Minimum Length	7 mm (0.27 in.)
Commutator End Frame Nuts	Torque	6 N•m (53 lb-in.)
Field Winding Terminal Nut	Torque	15 N•m (132 lb-in.)

OUOD006,0000059 –19–13AUG02–1/1

Iskra AZJ-Type Starter Motor Repair Specifications

Item	Measurement	Specification
New Brush	Length	23 mm (0.91 in.)
Used Brush	Minimum Length	13 mm (0.51 in.)
Engaging Lever Pivot Pin	Torque	12 N•m (106 lb-in.)
Commutator End Frame Nuts	Torque	6 N•m (53 lb-in.)
Field Winding Terminal Nut	Torque	15 N•m (132 lb-in.)

OUO1004,0000BAA –19–25SEP00–1/1

Iskra AZE, AZF-Type Starter Motor Test Specifications

					Solenoid Current		Pinion	
John Deere Starter Motor Part Number	Iskra Starter Motor Part Number	Starter Motor Model	System Voltage	Rating (kW)	Pull-In Winding (Amps)	Hold-In Winding (Amps)	No. of Teeth	Tooth Spacing (Modul)
RE505744	11.130.794	AZF4522	12	4.2	62	14	10	3.175
RE505745	11.130.793	AZF4521	12	3.4	62	14	10	2.54
RE505746	11.131.063	AZE4603	12	2.8	62	14	10	2.54
RE508322	11.131.060	AZF4541	12	4.2	62	14	10	3.175
RE509025	11.131.145	AZF4553	12	4.2	62	14	10	3.175
RE509903	11.131.092	AZF4550	12	4.2	62	14	10	3.175
RE516455	11.920.209	AZE4534	12	2.8	62	14	10	2.54
RE519568	11.920.209	AZE4534	12	2.8	62	14	10	2.54
RE521488	11.131.294	AZE4625	12	2.8	62	14	10	2.54
RE522334	11.131.266	AZF4575	24	4.0	30	6	10	3.175
RE522738	11.131.274	AZF4573	24	4.0	30	6	10	2.54
RE528532	11.131.254	AZF4571	24	4.0	30	630	10	3.175

75
10
6

OUOD006,000005A –19–07JUL05–1/1

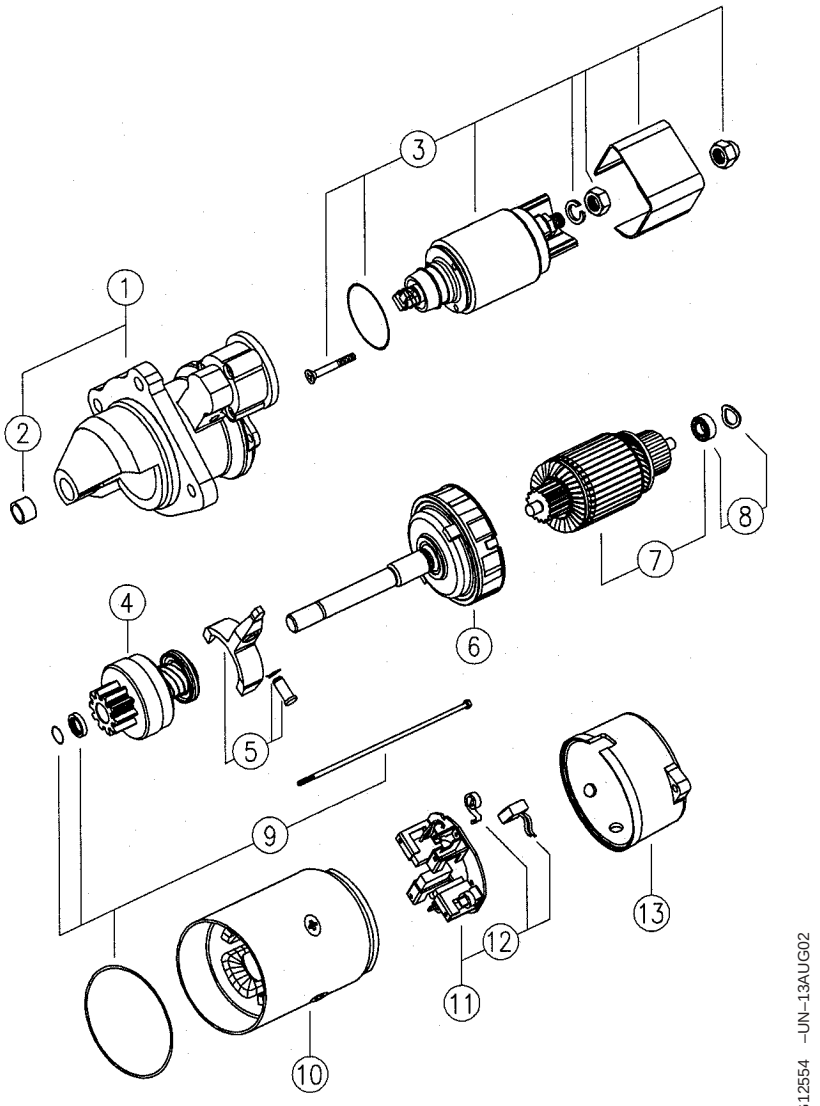
Iskra AZJ-Type Starter Motor Test Specifications

					Solenoid Current		Pinion	
John Deere Starter Motor Part Number	Iskra Starter motor Part Number	Motor Model	Starter System Voltage	Rating (kW)	Pull-In Winding (Amps)	Hold-In Winding (Amps)	No. of Teeth	Tooth Spacing (Modul)
RE500733	11.130.819	AZJ3283	12	3.1	62	14	10	2.54
RE501002[a]	11.130.762	AZJ3274	12	3.1	62	14	10	2.54
RE501766[a]	11.130.679	AZJ3326	12	3.1	62	14	10	3.175
RE501767								
RE501769[a]	11.130.745	AZJ3265	24	4.0	30	6	10	3.175
RE503093	11.130.796	AZJ3325	12	3.0	62	12	10	3.175
RE503118	11.130.797	AZJ3326	24	4.0	30	6	10	2.54
RE503119	11.130.798	AZJ3327	24	4.0	30	6	10	3.175
RE503120	11.130.799	AZJ3328	12	3.1	62	14	10	3.175
RE503632	11.130.936	AZJ3338	24	4.0	30	6	10	3.175
RE504009	11.130.940	AZJ3342	12	3.0	62	12	10	3.175
RE504915	11.130.977	AZJ3350	24	4.0	30	6	10	3.175
RE509100	11.131.072	AZJ3370	12	3.0	62	12	10	3.175
RE59010	11.130.605	AZJ3190	12	3.0	62	14	10	3.175
RE60239[a]	11.130.679	AZJ3226	12	3.1	62	14	10	3.175
RE60384	11.130.569	AZJ3181	12	3.1	62	14	10	2.54
RE67086	11.130.662	AZJ3214	24	4.0	30	6	10	2.54
RE67087	11.130.678	AZJ3225	24	4.0	30	6	10	3.175
RE68783	11.130.703	AZJ3241	12	3.1	62	14	10	3.175
RE71007[a]	111.307.45	AZJ3265	24	4.0	30	6	10	3.175

[a]Not a service part. For service, consult parts catalog.

RG,RG34710,2371 –19–07JUL05–1/1

Exploded View of Iskra Starter Motor (AZF-Type)



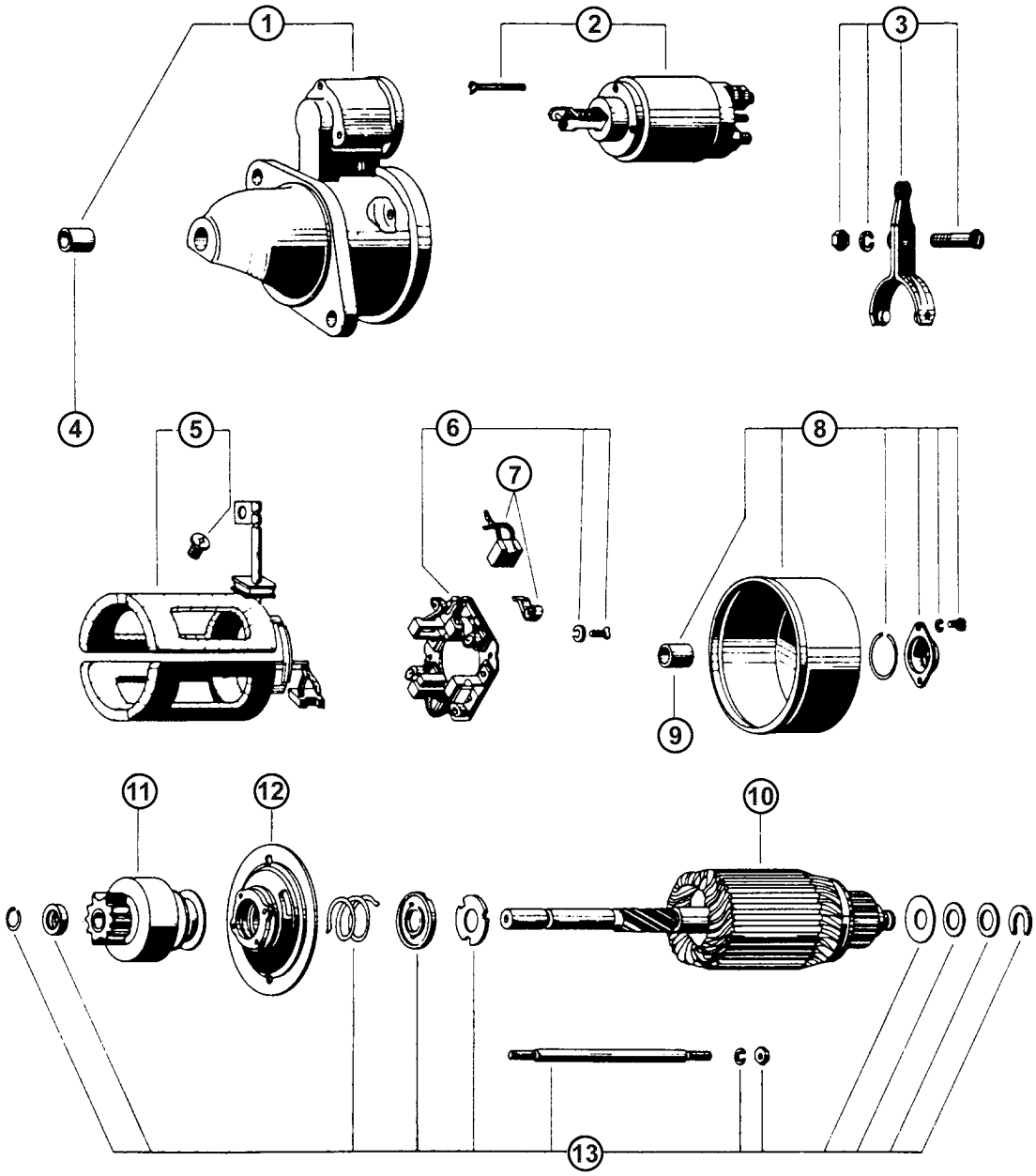
Iskra Starter Motor (AZF-Type)

1—Drive End Housing
2—Bushing, Drive End Bearing
3—Solenoid[1]
4—Drive Assembly
5—Engaging Lever[1]
6—Gear Reduction Assembly
7—Armature
8—Bearing
9—Parts Kit[1]
10—Field Coil
11—Brush Holder
12—Brush Kit[1]
13—Commutator End Frame

[1] Available as service parts.

OUOD006,000005B –19–13AUG02–1/1

Exploded View of Iskra Starter Motor (AZJ-Type)



RG12559 –UN–13AUG02

Iskra Starter Motor (AZJ-Type)

1—Drive End Housing
2—Solenoid[1]
3—Engaging Lever[1]
4—Bushing
5—Field Winding
6—Brush Holder
7—Brushes[1] (4 Used)
8—Commutator End Frame
9—Bushing
10—Armature
11—Overrunning Clutch Pinion[1]
12—Center Bearing
13—Service Parts Kit[1]

[1] Available as service parts.

RG,RG34710,2372 –19–14AUG02–1/1

Troubleshooting

Symptom	Problem	Solution
Fails to operate, no current draw	Open field circuit	Replace starter motor
	Open armature windings	Replace starter motor
	Defective brush contact with commutator	Clean brush holder or replace brushes
	Open solenoid windings	Replace solenoid
	Defective solenoid contact	Replace solenoid
Fails to operate, high current draw	Grounded field windings or armature windings	Replace starter motor
	Seized bearings	Replace starter motor
Low speed, low current draw	High internal resistance	Replace starter motor
	Defective brush contact with commutator	Clean brush holder or replace brushes
Low speed, high current draw	Shorted armature	Replace starter motor
	Grounded armature or field windings	Replace starter motor
High speed, high current draw	Shorted field windings	Replace starter motor
Solenoid switch operates but armature does not rotate	Worn or broken brushes	Clean brush holder and commutator and replace brushes
	Shorted field windings	Replace starter motor
Solenoid quickly engages and disengages	Shorted hold-in windings	Replace solenoid
Starter motor spins, but does not crank the engine	Overrunning clutch slipping	Replace overrunning clutch
	Pinion does not move into mesh with the gear ring	Replace engaging lever or clutch

RG,RG34710,2373 –19–15MAR97–1/1

Identification

The information for parts identification is stamped on the body of the starter motor as shown.

CD30490 –UN–03FEB97

Parts Identification

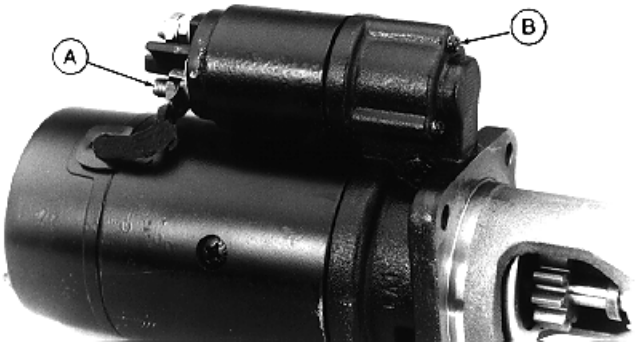
RG,RG34710,2374 –19–15MAR97–1/1

Disassembly of Starter Motor

NOTE: Before separating, mark parts so that they can be reinstalled in their original positions.

1. Disconnect field winding cable (A).
2. Remove the three screws holding the solenoid switch (B).

A—Field Winding Cable
B—Solenoid switch



CD30495 –UN–03FEB97

Field Winding Cable and Solenoid Switch

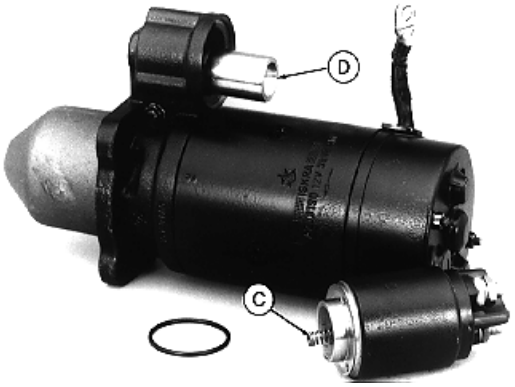
75
10
11

Continued on next page

RG,RG34710,2375 –19–15AUG02–1/7

3. Remove solenoid switch.
4. Extract spring (C) and plunger (D).

C—Spring
D—Plunger



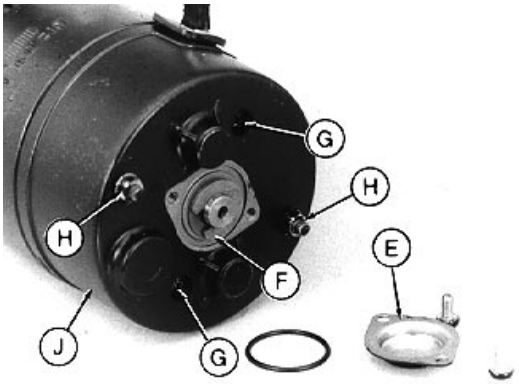
CD30496 –UN–03FEB97

Remove Solenoid Switch

RG,RG34710,2375 –19–15AUG02–2/7

5. **AZJ Only:** Remove cover (E).
6. **AZJ Only:** Remove clip and washers (F).
7. Remove screws (G) fixing the brush holder.
8. Unscrew nuts (H) and remove commutator end frame (J).

E—Cover
F—Clip and Washer
G—Brush Holder Fixing Screws
H—Nuts
J—Commutator End Frame



CD30497 –UN–03FEB97

Remove Components

Continued on next page

RG,RG34710,2375 –19–15AUG02–3/7

9. Remove insulation washer (K).

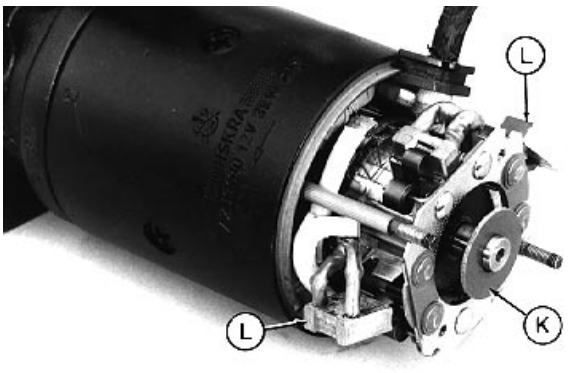
NOTE: Brushes are installed from the inside on AZF-type starters, and from the outside on AZJ-type starters.

10. **AZJ Only:** Extract positive brushes (L).

11. Install a dummy commutator as shown in Dealer Fabricated Tools earlier in this group.

    AZJ Only: Remove brush holder.

    AZF Only: Remove field coil together with brush holder away from armature. Remove dummy commutator from brush holder and pull brushes away from brush holder assembly, then remove brush holder.



CD30498 –UN–03FEB97

Remove Brush Holder

K—Insulation Washer
L—Brushes

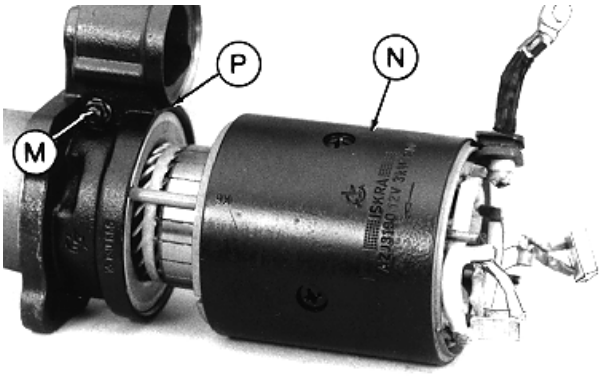
75
10
13

RG,RG34710,2375 –19–15AUG02–4/7

12. Remove pivot pin (M) from engaging lever.

13. Separate field winding frame (N) from armature/drive end housing assembly (P).

M—Pivot Pin
N—Field Winding Frame
P—Armature/Drive End Housing Assembly



CD30499 –UN–03FEB97

Separate Field Winding Frame

Continued on next page

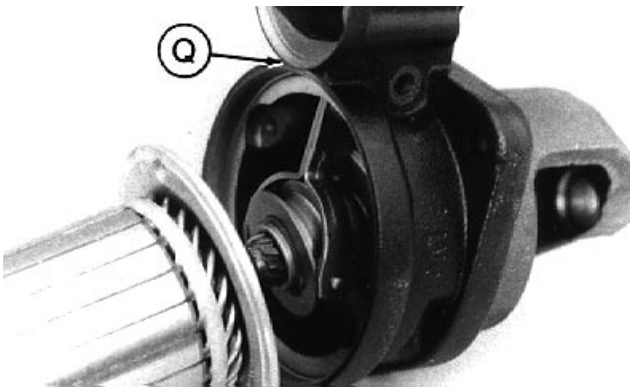
RG,RG34710,2375 –19–15AUG02–5/7

14. Remove studs.

15. **AZJ Only:** Extract armature with clutch and engaging lever from drive end housing (Q).

    AZF Only: Extract planetary gear assembly with clutch and engaging lever from drive end housing.

Q—Drive End Housing



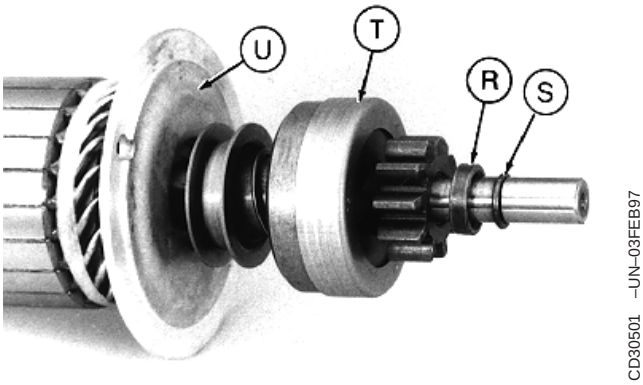
Drive End Housing

RG,RG34710,2375 –19–15AUG02–6/7

16. Using appropriate tool or self-made driver, as shown in Dealer Fabricated Tools earlier in this group, push in pinion stop (R) to have access to retaining ring (S).

17. Remove retaining ring and slide out of armature shaft the overrunning clutch (T), the center bearing (U) and, if equipped, the armature brake component.

R—Pinion Stop
S—Retaining Ring
T—Overrunning Clutch
U—Center Bearing

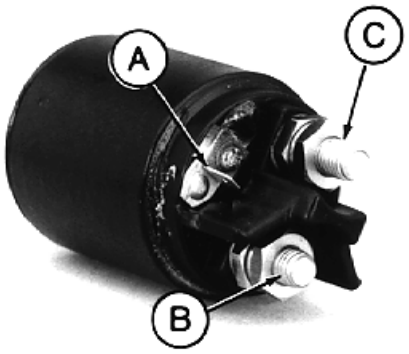


Remove Components

RG,RG34710,2375 –19–15AUG02–7/7

Testing Solenoid Switch

1. Check for continuity between solenoid terminal (A) and motor terminal (C). If there is no continuity, replace the solenoid switch. (Resistance should be approximately 0.3 ohms.)
2. Check for continuity between solenoid terminal (A) and the steel casing. If there is no continuity, replace the solenoid switch. (Resistance should be approximately 0.9 ohms.)
3. Perform this test with the plunger and spring in the solenoid body. Prevent the plunger from falling out after disconnecting power. Apply appropriate voltage (12 volts or 24 volts) between solenoid terminal (A) and the steel casing. Connect a ground wire capable of 60 amps between motor terminal (C) and the steel casing. The plunger should pull in. Disconnect the ground wire, and the plunger should remain held in. Connect the ohmmeter between terminals (B) and (C). There should be continuity only when the plunger is held in. Disconnect power, and the pinion plunger should extend. If any test above fails, replace the solenoid switch.



CD30502 –UN–03FEB97

Testing Solenoid Switch

A—Solenoid Terminal
B—Battery Terminal
C—Motor Terminal

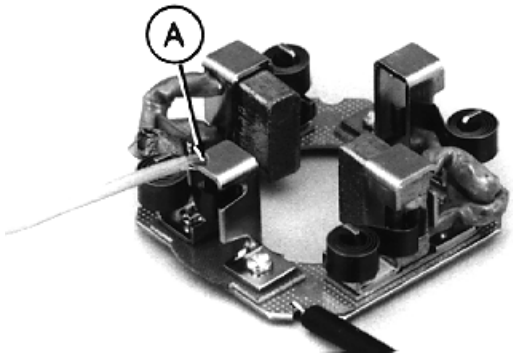
RG,RG34710,2376 –19–20SEP02–1/1

Testing Brushes

1. Check positive brush holder (A) by connecting an ohmmeter between brushes and plate. If the resistance is not infinity, replace starter motor.
2. Inspect brushes. Brushes must move freely in their guides. Check brush overall length. Replace brushes if frozen or too worn.

Specification

New Brush (AZF)—Length	19.5 mm (0.77 in.)
New Brush (AZJ)—Length	23 mm (0.91 in.)
Used Brush (AZF)—Minimum Length	7 mm (0.27 in.)
Used Brush (AZJ)—Minimum Length	13 mm (0.51 in.)



CD30503 –UN–03FEB97

Test Brushes

A—Brush Holder

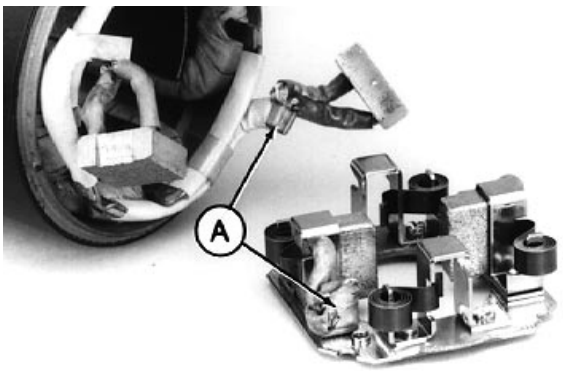
RG,RG34710,2377 –19–16AUG02–1/1

Brush Replacement

1. Cut off old brush at end of brush strand (A).
2. Solder new brush using a 40—60% tin-lead mix. Heat to 230°C (446°F).

NOTE: This operation needs a specialized tooling. Eventually, have the brushes replaced by a local electrical repair station.

A—Brush Strand



CD30504 –UN–03FEB97

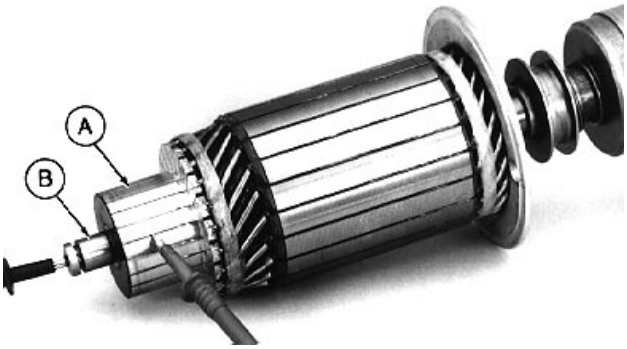
Cut off Brush at End of Strand

DPSG,OUOE003,30 –19–18DEC98–1/1

Testing Armature

75
10
16

1. Check the armature insulation by connecting an ohmmeter between the commutator (A) and the shaft (B). If test shows continuity (needle movement), the armature is grounded.
2. Check for armature condition. Space between bars must be clean and regular. Small defects can be eliminated using sandpaper and lathe.
3. If insulation is defective or armature is quite worn, replace the complete starter motor.



CD30505 –UN–03FEB97

Test Armature

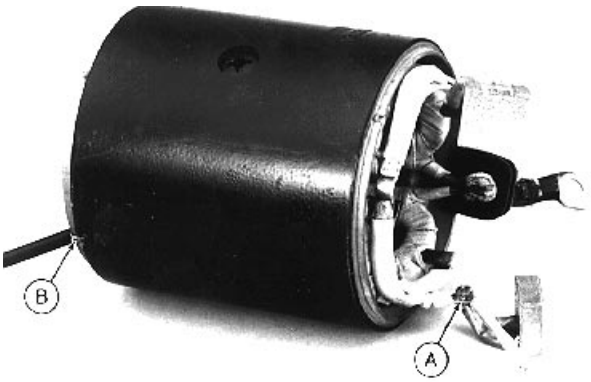
A—Commutator
B—Shaft

RG,RG34710,2378 –19–15MAR97–1/1

Testing Field Windings

Check insulation by connecting an ohmmeter between brush (A) and field frame (B). If ohmmeter swings toward zero, a grounded circuit is indicated. If defective, replace the complete starter motor.

A—Brush
B—Field Frame



CD30506 –UN–03FEB97

Test Field Windings

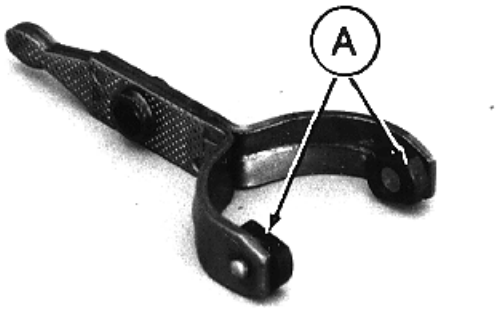
RG,RG34710,2379 –19–15MAR97–1/1

Checking Engaging Lever

NOTE: Engaging lever on AZF-type starters looks different than on AZJ-type starters, but the inspection is the same.

Inspect wear pads (A) for excessive wear or damage. Replace engaging lever if necessary.

A—Wear Pads



CD30507 –UN–03FEB97

Inspect Wear Pads

RG,RG34710,2380 –19–16AUG02–1/1

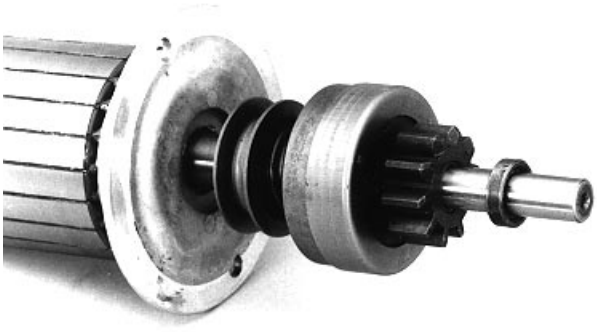
Checking Overrunning Clutch Pinion

1. Check for pinion tooth condition. Slight damage to teeth can be eliminated by grinding.

NOTE: Damage to teeth can be caused by a malfunction of electrical system. Also check electrical circuit for proper operation (switch, relay etc.).

2. Turn overrunning clutch pinion by hand. Clutch pinion should turn freely on shaft in overrunning direction only.

3. If defective, replace overrunning clutch pinion.



CD30508 –UN–03FEB97

Check Overrunning Clutch Pinion

RG,RG34710,2381 –19–15MAR97–1/1

Reassembly of Starter Motor

75
10
18

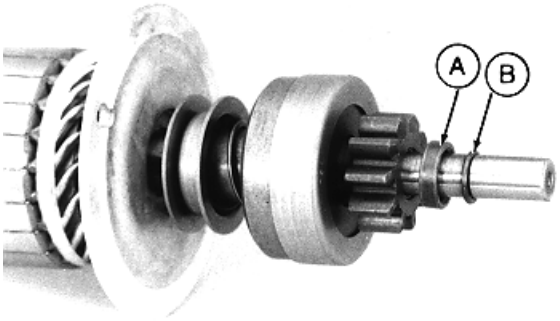
NOTE: Use petrolatum-base grease to lubricate mechanical parts such as shaft in nose bushing, overrunning clutch pinion on shaft, and shaft in rear bearing.

Use service parts kit when reassembling the starter motor. (See (N) in exploded view earlier in this group.)

1. Install pinion stop (A) with cupped side toward shaft end.

2. Install retaining ring (B) using suitable tools or self-made tools as shown in Dealer Fabricated Tools earlier in this group.

3. Force pinion stop over retaining ring.



CD30509 –UN–03FEB97

Reassemble Starter Motor

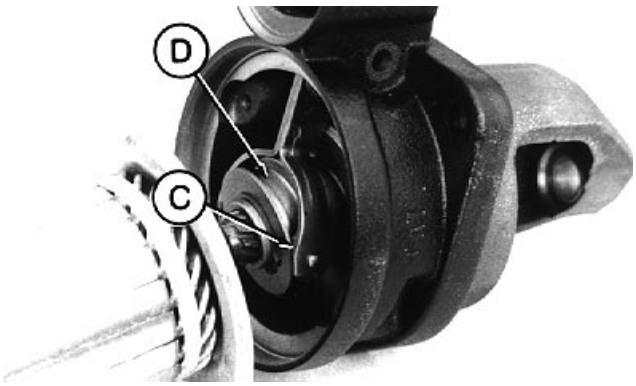
A—Pinion Stop
B—Retaining Ring

Continued on next page

RG,RG34710,2382 –19–16AUG02–1/8

4. Install armature and engaging lever into drive end housing. Engaging lever pads (C) must engage in groove (D) of drive pinion.

C—Engaging Lever Pads
D—Drive Pinion Groove



Armature and Engaging Lever

RG,RG34710,2382 –19–16AUG02–2/8

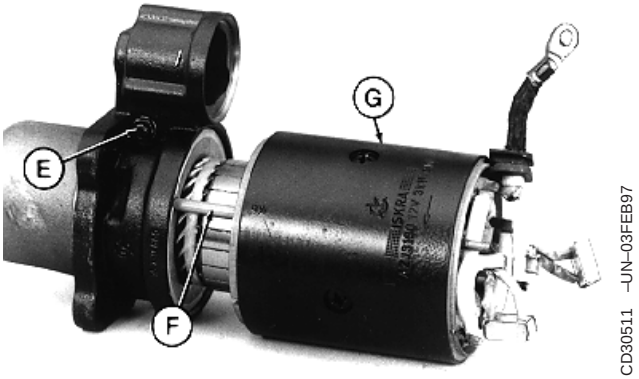
NOTE: Tightening specification applies to AZJ-type starters only. AZF-type starters use a pin and snap ring.

5. Install pivot pin (E). Tighten to specifications. (AZJ-type starters only.)

Specification	
Engaging Lever Pivot Pin—Torque	12 N•m (106 lb-in.)

6. Screw in studs (F) with insulation sleeve.

7. Slide field winding frame (G) over armature.



Field Winding Frame

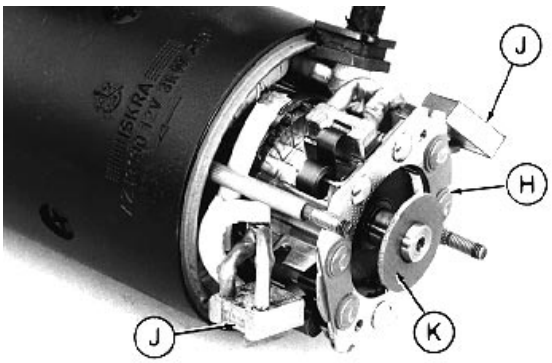
E—Pivot Pin
F—Studs
G—Field Winding Frame

Continued on next page

RG,RG34710,2382 –19–16AUG02–3/8

8. Slide brush holder (H) onto commutator. Remove the dummy commutator.
9. Install positive brushes (J).
10. Install insulation washer (K).

H—Brush Holder
J—Brushes
K—Insulation Washer



CD30512 –UN–03FEB97

Install Parts

RG,RG34710,2382 –19–16AUG02–4/8

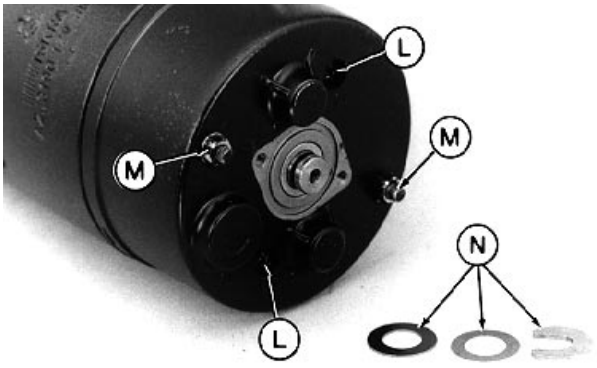
11. Install commutator end frame.
12. Screw in screws (L) for the brush holder and secure.
13. Install washers and nuts (M). Tighten to specifications.

Specification

Commutator End Frame Nuts—
Torque ..... 6 N•m (53 lb-in.)

14. Install thrust washers and clip (N).

L—Screws
M—Washers and Nuts
N—Thrust Washers and Clip



CD30513 –UN–03FEB97

Install Commutator End Frame

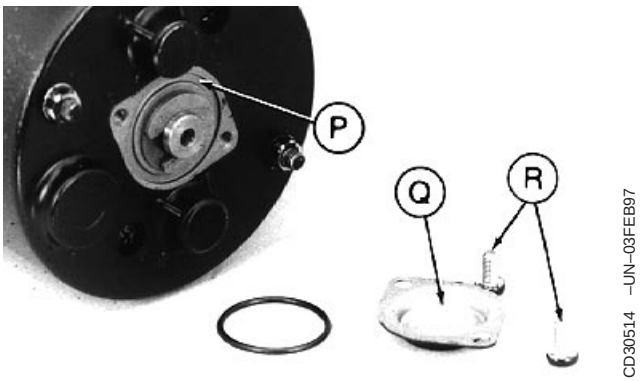
Continued on next page

RG,RG34710,2382 –19–16AUG02–5/8

15. Install O-ring into groove (P).

16. Put grease into cover (Q) and install cover. Tighten screws (R).

P—Groove
Q—Cover
R—Screws (2 Used)



Install Cover

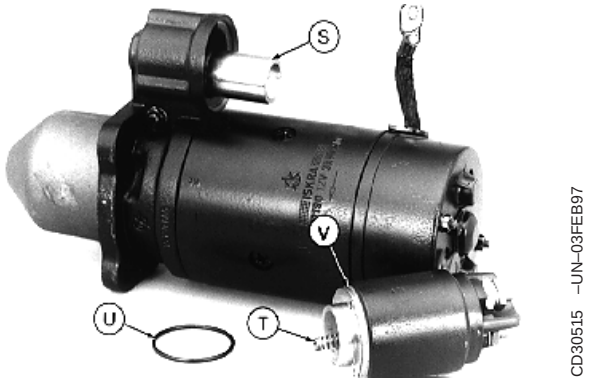
RG,RG34710,2382 –19–16AUG02–6/8

17. Install plunger end (S) onto engaging lever.

18. Slide spring (T) into solenoid body.

19. Install O-ring (U) into groove of body pilot (V).

S—Plunger
T—Spring
U—O-Ring
V—Solenoid Body Pilot Groove



Assemble Parts

Continued on next page

RG,RG34710,2382 –19–16AUG02–7/8

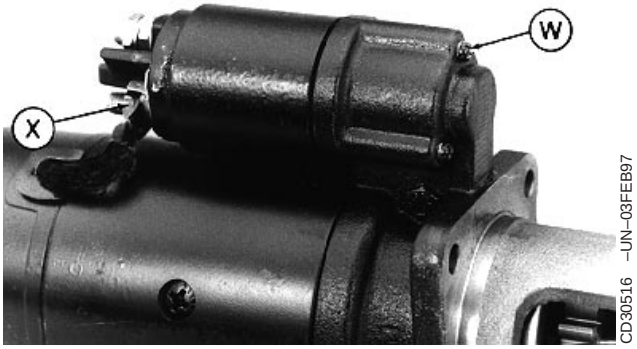
20. Install solenoid body onto starter motor. Tighten screws (W).

21. Connect field winding cable. Tighten nut (X) to specifications.

Specification

Field Winding Terminal Nut—
Torque ..... 15 N•m (132 lb-in.)

W—Solenoid Body Screws
X—Field Winding Cable Nut



Tighten Screw and Nut

RG,RG34710,2382 –19–16AUG02–8/8

75
10
22

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000BA7 –19–08MAY02–1/3

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUO1004,0000BA7 –19–08MAY02–2/3

Alternator, Generator, Starter and Battery Bench Tester. JT01760

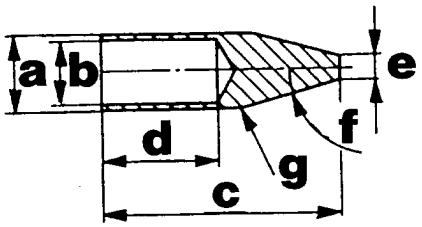
Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000BA7 –19–08MAY02–3/3

Dealer Fabricated Tools

Pilot for Retaining Ring Installation

a—Dia. 11.40 mm (0.449 in.)
b—Dia. 10.24 mm (0.403 in.)
c—50 mm (1.97 in.)
d—18.50 mm (0.728 in.)
e—5 mm (0.20 in.)
f—30°
g—R10 mm (0.39 in.)



CD30492 –UN–31JAN97

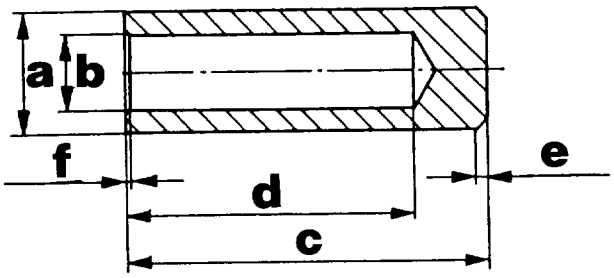
Pilot for Retaining Ring

OUOD006,0000060 –19–14AUG02–1/3

Driver for Retaining Ring Installation and for Pinion Stop Removal

75
15
2

a—Dia. 16 mm (0.63 in.)
b—Dia. 11.5 mm (0.453 in.)
c—75 mm (2.95 in.)
d—60 mm (2.36 in.)
e—Chamfer 45° x 2 mm (0.08 in.)
f—Chamfer 45° x 2 mm (0.08 in.)



CD30493 –UN–03FEB97

Driver for Retaining Ring and Pinion Stop

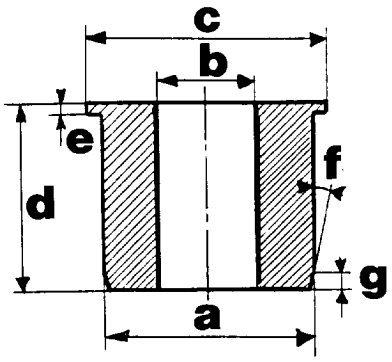
Continued on next page

OUOD006,0000060 –19–14AUG02–2/3

Dummy Commutator for Brush Holder Removal and Installation

Material: Plastic

a—Dia. 31 mm (1.22 in.)
b—Dia. 11 mm (0.43 in.)
c—Dia. 35 mm (1.38 in.)
d—35 mm (1.38 in.)
e—2.5 mm (0.10 in.)
f—Chamfer 15°
g—2 mm (0.08 in.)



CD30494 –UN–31JAN97

Dummy Commutator for Brush Holder

OUOD006,0000060 –19–14AUG02–3/3

Iskra AZE-Type Starter Motor Repair Specifications

75
15
3

Item	Measurement	Specification
New Brush	Length	14.5 mm (0.57 in.)
Used Brush	Minimum Length	7 mm (0.27 in.)
Commutator End Frame Nuts	Torque	5.8 N•m (51 lb-in.)
Field Winding Terminal Nut	Torque	15 N•m (132 lb-in.)

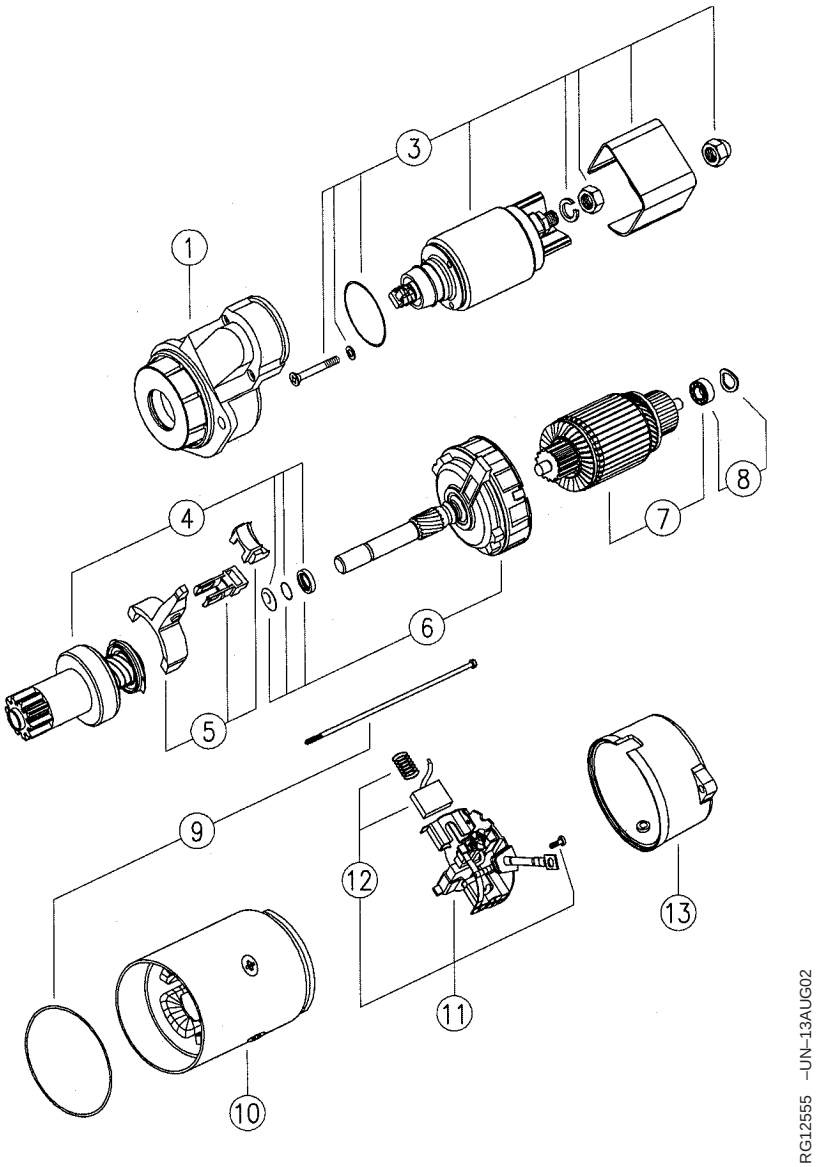
OUO1004,0000BAA –19–07MAY02–1/1

Iskra AZE-Type Starter Motor Test Specifications

					Solenoid Current		Pinion	
John Deere Part Number	Iskra Part Number	Motor Model	System Voltage	Rating (kW)	Pull-In Winding (Amps)	Hold-In Winding (Amps)	No. of Teeth	Tooth Spacing (Modul)
RE505746	11.131.063	AZE4603	12	2.8	62	14	10	2.54

RG,RG34710,2371 –19–07MAY02–1/1

Exploded View of AZE (Noseless)-Type Starter Motor



Iskra Starter Motor (AZE-Type)

1—Drive End Housing
2—Bushing, Drive End Bearing
3—Solenoid[1]
4—Drive Assembly
5—Engaging Lever
6—Gear Reduction Assembly
7—Armature
8—Bearing
9—Parts Kit
10—Field Coil
11—Brush Holder
12—Brush Kit
13—Commutator End Frame

[1] Available as service parts.

OUOD006,0000012 –19–07MAY02–1/1

Troubleshooting

Symptom	Problem	Solution
Fails to operate, no current draw	Open field circuit	Replace starter motor
	Open armature windings	Replace starter motor
	Defective brush contact with commutator	Clean brush holder or replace brushes
	Open solenoid windings	Replace solenoid
	Defective solenoid contact	Replace solenoid
Fails to operate, high current draw	Grounded field windings or armature windings	Replace starter motor
	Seized bearings	Replace starter motor
Low speed, low current draw	High internal resistance	Replace starter motor
	Defective brush contact with commutator	Clean brush holder or replace brushes
Low speed, high current draw	Shorted armature	Replace starter motor
	Grounded armature or field windings	Replace starter motor
High speed, high current draw	Shorted field windings	Replace starter motor
Solenoid switch operates but armature does not rotate	Worn or broken brushes	Clean brush holder and commutator and replace brushes
	Shorted field windings	Replace starter motor
Solenoid quickly engages and disengages	Shorted hold-in windings	Replace solenoid
Starter motor spins, but does not crank the engine	Overrunning clutch slipping	Replace overrunning clutch
	Pinion does not move into mesh with the gear ring	Replace engaging lever or clutch

75
15
5

OUOD006,0000013 –19–07MAY02–1/1

Identification

The information for parts identification is stamped on the body of the starter motor as shown.

RG12556 –UN–27AUG02

Parts Identification

OUOD006,0000014 –19–07MAY02–1/1

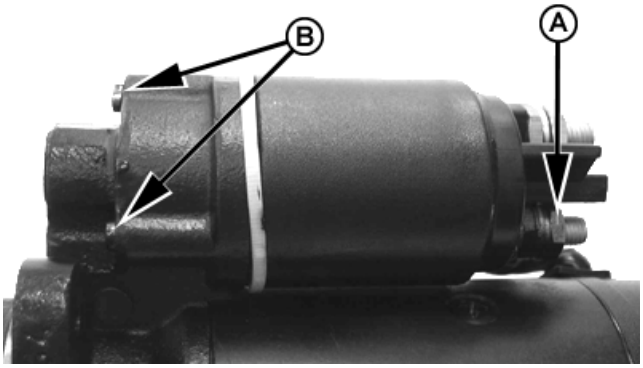
Removing Solenoid Switch

75
15
6

NOTE: Before separating, mark parts for reinstallation in original position.

1. Disconnect nut (A) and field lead from solenoid.
2. Remove three cap screws (B) holding solenoid switch to housing.
3. Remove solenoid switch.

A—Nut (Field Lead)
B—Cap Screw (3 used)



RG12557 –UN–27AUG02

Remove Solenoid Switch

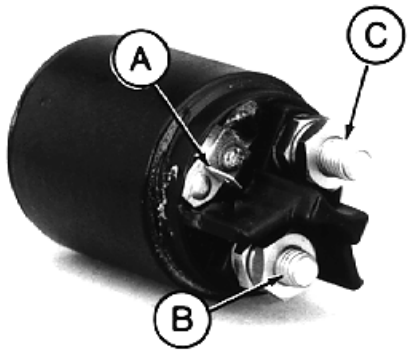
OUOD006,000005C –19–13AUG02–1/1

Testing Solenoid Switch

1. Check for continuity between solenoid terminal (A) and motor terminal (C). If there is no continuity, replace the solenoid switch. (Resistance should be approximately 0.3 ohms.)

2. Check for continuity between solenoid terminal (A) and the steel casing. If there is no continuity, replace the solenoid switch. (Resistance should be approximately 0.9 ohms.)

3. Perform this test with the plunger and spring in the solenoid body. Prevent the plunger from falling out after disconnecting power. Apply appropriate voltage (12 volts or 24 volts) between solenoid terminal (A) and the steel casing. Connect a ground wire capable of 60 amps between motor terminal (C) and the steel casing. The plunger should pull in. Disconnect the ground wire, and the plunger should remain held in. Connect the ohmmeter between terminals (B) and (C). There should be continuity only when the plunger is held in. Disconnect power, and the pinion plunger should extend. If any test above fails, replace the solenoid switch.



CD30502 –UN–03FEB97

Testing Solenoid Switch

A—Solenoid Terminal
B—Battery Terminal
C—Motor Terminal

75
15
7

RG,RG34710,2376 –19–20SEP02–1/1

Installing Solenoid Switch

IMPORTANT: Handle (A) of plunger (B) must be connected to engaging lever.

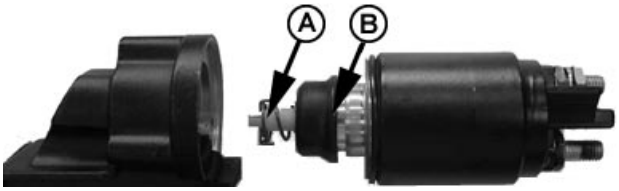
1. Install three cap screws (C).
2. Install field lead onto terminal with nut (D). Tighten to specifications.

Specification

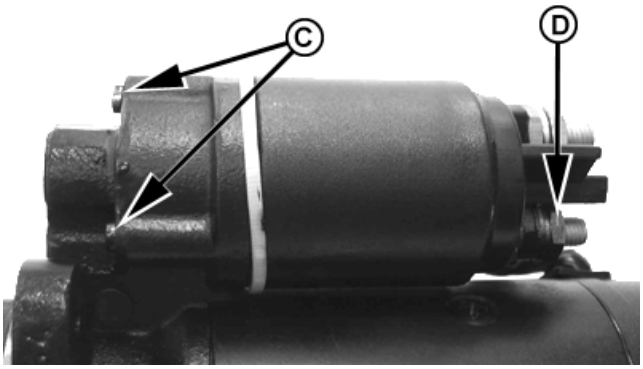
Field Lead Terminal Nut—Torque..... 15 N•m (132 lb-in.)

A—Handle
B—Plunger
C—Cap Screw (3 used)
D—Nut (Field Lead)

RG12558 –UN–27AUG02



Check Plunger Handle Connection



RG12561 –UN–27AUG02

Install Solenoid Switch

75
15
8

OUOD006,000005E –19–13AUG02–1/1

Section 80
Valeo Starter Motors

Contents

General Information

IMPORTANT: Never operate starter motor longer than 30 seconds. Allow at least 2 minutes for cooling and battery recovery before operating again. Overheating caused by excessive operation will seriously damage starter motor.

RG,RG34710,2383 –19–15MAR97–1/1

Typical Starting Circuit Operation

When wire from relay (A) is energized, current flows through both pull-in winding (C) and hold-in winding (D) to ground.

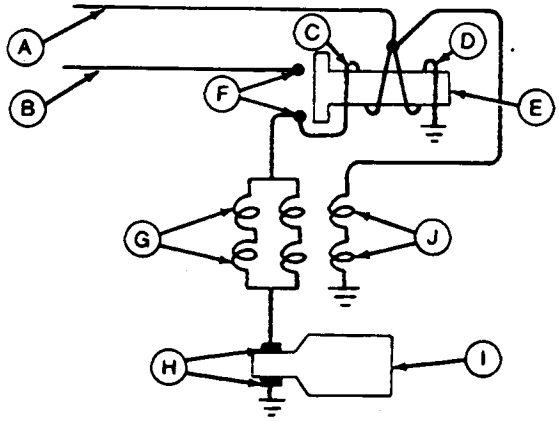
Current through windings engages solenoid plunger (E), which closes main contacts (F). When main contacts close, current through pull-in windings stops. Current continues through hold-in winding, keeping solenoid engaged and main contacts closed.

With main contacts closed, current flows from battery cable (B) to starter motor at a very high rate. Four heavy field windings (G) carry current to commutator brushes (H).

Light shunt windings (J) are wrapped together with two of the heavy field windings. Shunt windings are connected to solenoid switch terminal and directly to ground. They provide additional low speed torque to assist engine rotation and prevent overspeeding of motor.

From field windings, current flows through armature windings (I) to ground, making contact through commutator brushes (H).

Strong magnetic fields are set up by current flow through field windings and armature windings. Windings are arranged so that magnetic fields constantly repel each other, rotating armature.



RG1313 –UN–20APR89

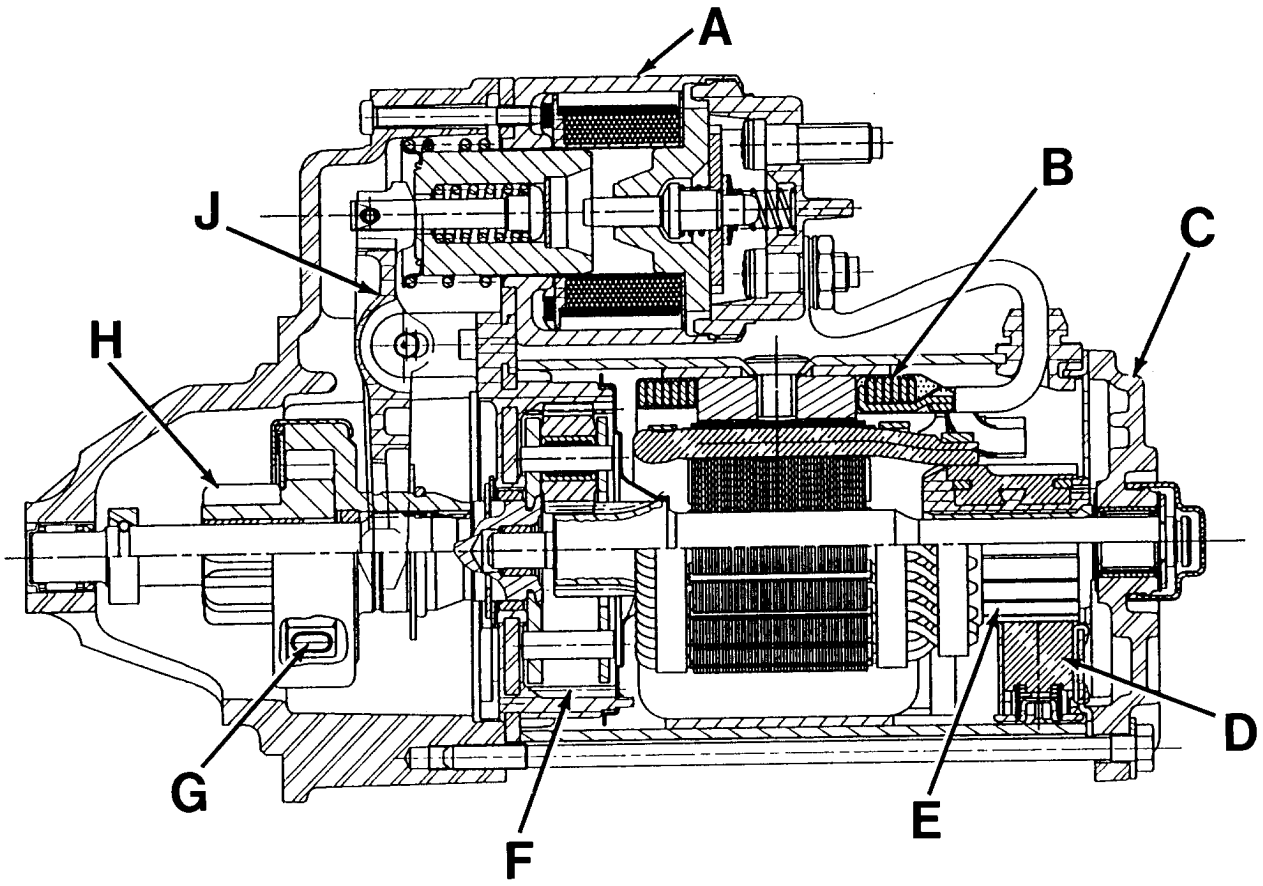
Typical Starting Circuit Operation

A—Wire From Relay
B—Cable from Battery
C—Pull-In Winding
D—Hold-In Winding
E—Solenoid Plunger
F—Main Contacts
G—Field Windings
H—Commutator Brushes
I—Armature
J—Shunt Windings

80
05
1

RG,RG34710,2384 –19–15MAR97–1/1

Typical Starter Motor Operation



CD30450 –UN–17JUL96

Typical Starter Motor Operation

A—Solenoid Switch
B—Field Winding
C—Rear Bearing
D—Brush
E—Commutator
F—Gear Reduction Assembly
G—Overrunning Clutch
H—Pinion
J—Engaging Lever

When solenoid (A) engages, it pulls engaging lever (J). Lever pushes overrunning clutch drive (G) to engage pinion in starter gear on flywheel. As armature turns, it cranks engine.

When engine starts, overrunning clutch spins freely on shaft. This prevents overspeeding of armature by flywheel.

When key switch is released, current to solenoid hold-in winding is shut off. Current can feed through both pull-in and hold-in windings from main contacts, but direction of current is reversed in pull-in winding.

The two windings cancel each other, and solenoid is released.

A spring pushes solenoid back to disengaged position. This opens main contacts and shuts off current to field windings and armature.

Shift lever retracts overrunning clutch drive, disengaging pinion from flywheel.

In this reduction-type starter, the speed of armature rotation is reduced by the gear reduction assembly (F).

RG,RG34710,2385 –19–15MAR97–1/1

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000BAB –19–08MAY02–1/3

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

80
10
1

OUO1004,0000BAB –19–08MAY02–2/3

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

OUO1004,0000BAB –19–08MAY02–3/3

Valeo Starter Motor Repair Specifications

Item	Measurement	Specification
New Brush	Length	14 mm (0.55 in.)
Used Brush	Minimum Length	8.5 mm (0.22 in.)
Starter Solenoid Mounting Cap Screws	Torque	3 N•m (27 lb-in.)
Housing Through Bolts	Torque	7 N•m (62 lb-in.)
Field Winding Terminal Screw	Torque	10 N•m (88 lb-in.)

OUO1004,0000BAE –19–25SEP00–1/1

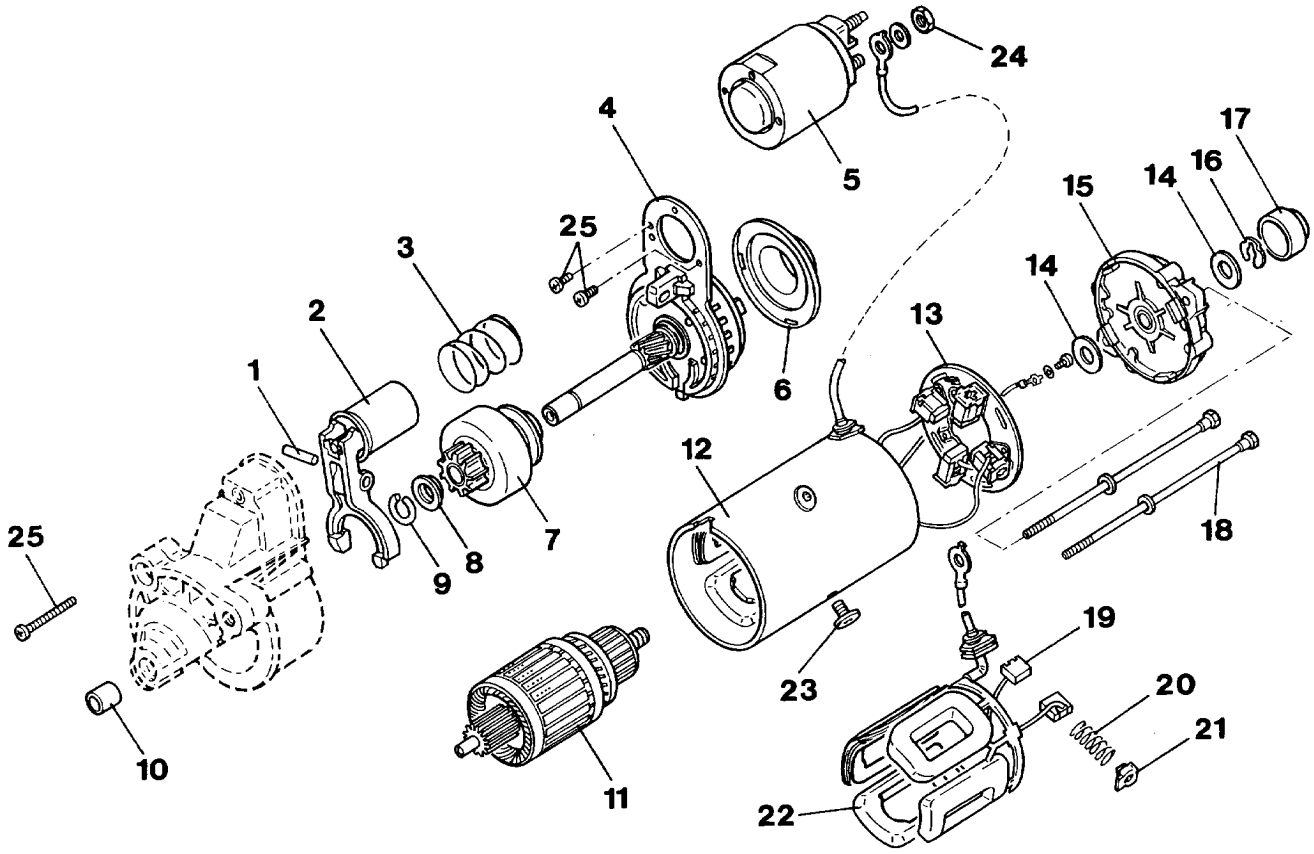
Valeo Starter Motor Test Specifications

John Deere Starter Motor Part No.	Valeo Starter Motor Part No.	Valeo Model	System Voltage	Rating (kW)	Solenoid Current Hold-In Windings (Amps)
RE501680	187031	D7R14	12	2.5	32
RE502156	187031	D7R14	12	2.5	32
RE60641[a]	187031	D7R14	12	2.5	32
[a]Not a service part. For service, consult parts catalog.					

80
10
2

RG,RG34710,2387 –19–07JUL05–1/1

Exploded View of Starter Motor



CD30451 –UN–17JUL96

Starter Motor

1—Pivot Pin[1]
2—Engaging Lever/Plunger Assembly
3—Solenoid Spring
4—Gear Reduction Assembly
5—Solenoid Body[1]
6—Cover
7—Overrunning Clutch Pinion[1]
8—Pinion Stop[1]
9—Retaining Ring[1]
10—Bushing[1]
11—Armature
12—Field Frame
13—Brush Plate[1]
14—Shim[1]
15—Rear Bearing
16—Clip[1]
17—Plastic Cap[1]
18—Through Bolt[1] (2 used)
19—Brush[1] (4 used)
20—Brush Spring[1]
21—Clip[1]
22—Field Winding
23—Pole Shoe Screw
24—Field Winding Terminal Nut
25—Solenoid Attaching Screw (3 Used)

[1] Available as service parts.

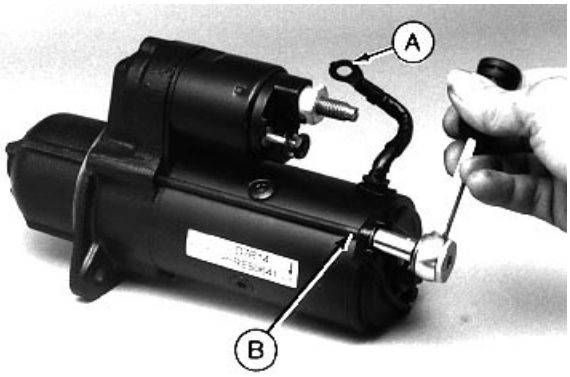
RG,RG34710,2395 –19–15MAR97–1/1

80 10 3

Disassembly of Starter Motor

1. Disconnect field winding cable (A).
2. Unscrew the two through bolts (B).

A—Field Winding Cable
B—Through Bolts (2 Used)



CD30452 –UN–22JUL96

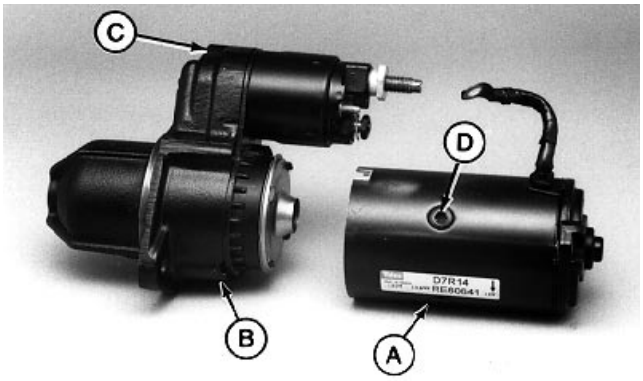
Starter Motor Disassembly

RG,RG34710,2388 –19–12SEP02–1/11

3. Separate electric motor (A) from complete front assembly (B).
4. Unscrew the screw (C) holding the contactor using a TORX® screwdriver.

NOTE: Do not unscrew the pole shoe screws (D) as it is difficult to perform the tightening procedure.

A—Electric Motor
B—Front Assembly
C—Contactor Screw
D—Pole Shoe Screws



CD30453 –UN–22JUL96

Separate Electric Motor

TORX is a registered trademark of Camcar/Textron.

Continued on next page

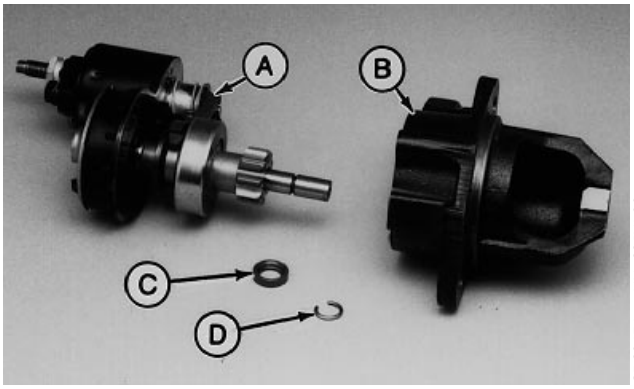
RG,RG34710,2388 –19–12SEP02–2/11

5. Separate gear reduction/solenoid/overrunning clutch assembly (A) from drive end housing (B).

6. Push pinion stop (C) toward pinion to have access to the retaining ring (D).

7. Remove retaining ring and slide pinion stop off shaft.

A—Gear Reduction/Solenoid/Overrunning Clutch Assembly
B—Drive End Housing
C—Pinion Stop
D—Retaining Ring



CD30454 –UN–22JUL96

Slide Pinion Stop Off Shaft

RG,RG34710,2388 –19–12SEP02–3/11

8. Remove pivot pin (A).

A—Pivot Pin

CD30455 –UN–22JUL96

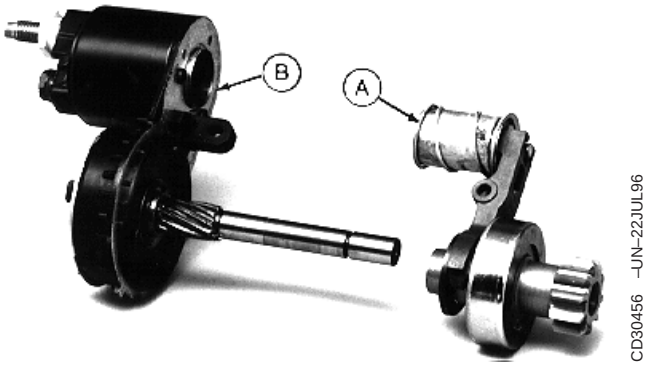
Remove Pivot Pin

Continued on next page

RG,RG34710,2388 –19–12SEP02–4/11

9. Separate overrunning clutch/engaging lever/mobile core assembly (A) from gear reduction/solenoid body assembly (B).

A—Overrunning Clutch/Engaging Lever/Mobile Core Assembly
B—Gear Reduction/Solenoid Body Assembly

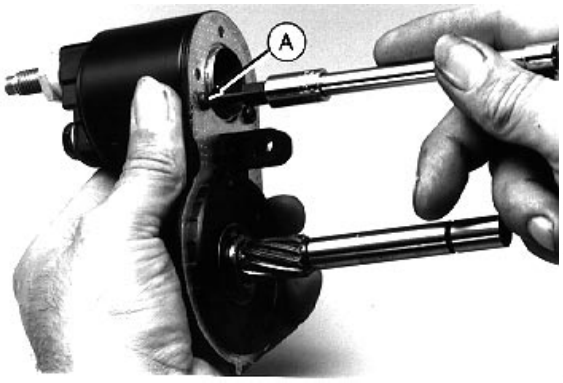


Separate Assemblies

RG,RG34710,2388 –19–12SEP02–5/11

10. Unscrew the two screws holding the contactor (A) using TORX® screwdriver.

A—Screws (2 used)



Contactor

TORX is a registered trademark of Camcar/Textron.

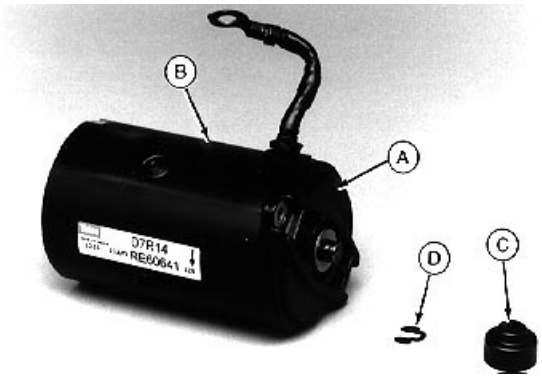
Continued on next page

RG,RG34710,2388 –19–12SEP02–6/11

11. Before disassembly, mark both the rear bearing (A) and the field frame (B).

12. Remove rear plastic cap (C) and clip (D).

A—Rear Bearing
B—Field Frame
C—Rear Plastic Cap
D—Clip



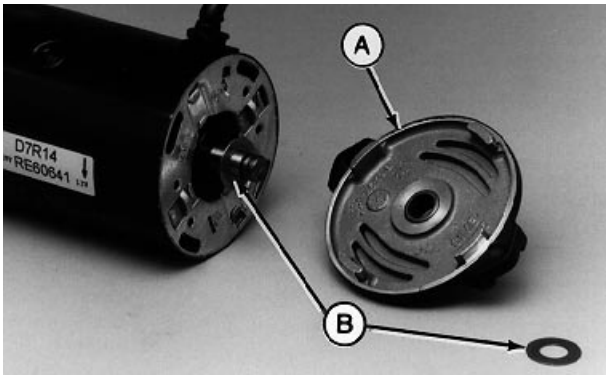
Cap and Clip

RG,RG34710,2388 –19–12SEP02–7/11

13. Remove the rear bearing (A).

NOTE: Two shims (B) are located on each side of rear bearing.

A—Rear Bearing
B—Shims (4 Used)



Remove Rear Bearing

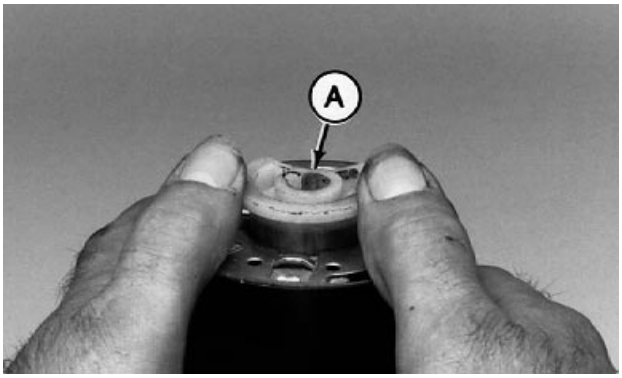
Continued on next page

RG,RG34710,2388 –19–12SEP02–8/11

14. Position and push the disassembly sleeve (A) on the shaft to hold brushes in their housing and remove the armature.

NOTE: The disassembly sleeve (A) is provided with the brush repair kit available through John Deere.

A—Disassembly Sleeve



Disassembly Sleeve

RG,RG34710,2388 –19–12SEP02–9/11

15. Slide carbon brush plate away from the field frame.

16. Loosen and remove the four brush clips from the plate. Take care to avoid losing the four springs.

17. Remove the disassembly sleeve.

Remove the Disassembly Sleeve

Continued on next page

RG,RG34710,2388 –19–12SEP02–10/11

18. Push the two positive brushes inwards and remove the brush plate from the field frame.

CD30462 –UN–22JUL96

Remove Brush Plate

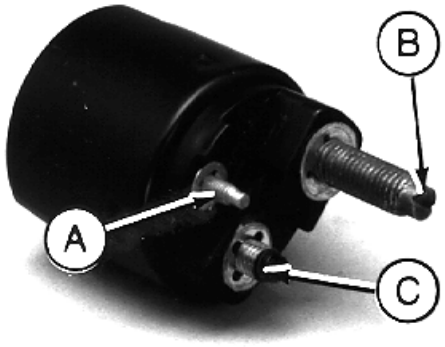
RG,RG34710,2388 –19–12SEP02–11/11

Testing Solenoid Switch

1. Check for continuity between solenoid terminal (A) and motor terminal (C). If there is no continuity, replace the solenoid switch. (Resistance should be approximately 0.3 ohms.)

2. Check for continuity between solenoid terminal (A) and the steel casing. If there is no continuity, replace the solenoid switch. (Resistance should be approximately 0.9 ohms.)

3. Perform this test with the plunger and spring in the solenoid body. Prevent the plunger from falling out after disconnecting power. Apply appropriate voltage (12 volts or 24 volts) between solenoid terminal (A) and the steel casing. Connect a ground wire capable of 60 amps between motor terminal (C) and the steel casing. The plunger should pull in. Disconnect the ground wire, and the plunger should remain held in. Connect the ohmmeter between terminals (B) and (C). There should be continuity only when the plunger is held in. Disconnect power, and the pinion plunger should extend. If any test above fails, replace the solenoid switch.



CD30463 –UN–22JUL96

Testing Solenoid Switch

A—Solenoid Terminal
B—Battery Terminal
C—Motor Terminal

80
10
9

RG,RG34710,2389 –19–20SEP02–1/1

Testing Brushes

1. Check positive brushes (A) by connecting an ohmmeter between brushes and plate. The resistance should be infinity.

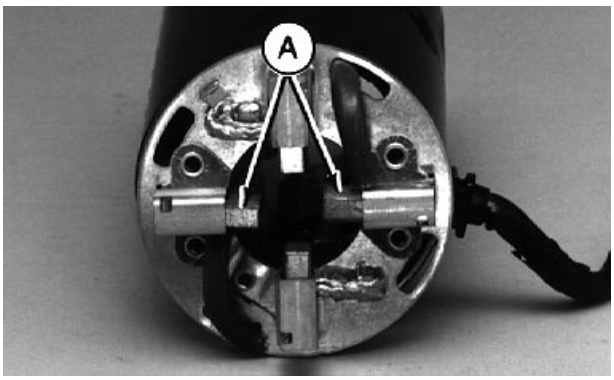
2. Inspect brushes. Brushes must move freely in their guides. Check brush overall length.

Specification

New Brush—Length ..... 14 mm (0.55 in.)
Used Brush—Minimum Length ..... 8.5 mm (0.22 in.)

3. If defective, replace the brush plate assembly.

NOTE: Brush plate assembly is available as a John Deere Service part.



Test Brushes

A—Brushes

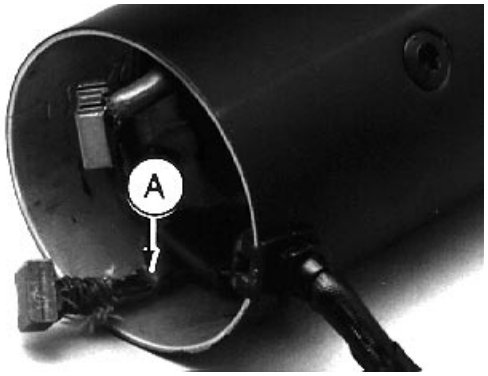
RG,RG34710,2390 –19–15MAR97–1/1

Positive Brush Replacement

1. Cut off old brush at end of brush strand (A).

2. Solder new brush using a 40—60% tin-lead mix. Heat to 230°C (446°F).

NOTE: This operation requires specialized soldering tools. If not available, have the brushes replaced by a local electrical repair station.



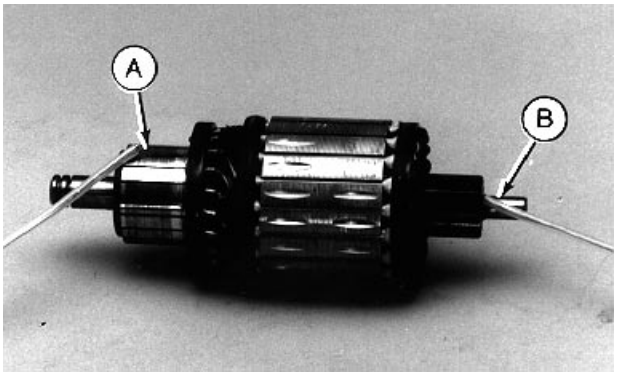
Positive Brush Replacement

A—Brush Strand

RG,RG34710,2391 –19–15MAR97–1/1

Testing Armature

1. Check the armature insulation by connecting an ohmmeter between the commutator (A) and the shaft (B). If test shows continuity (needle movement), the armature is grounded.
2. Check for armature condition. Space between bars must be clean and of even depth. Small defects can be eliminated using sandpaper and a lathe.
3. If insulation is defective or armature is quite worn, replace the complete starter motor.



Test Armature

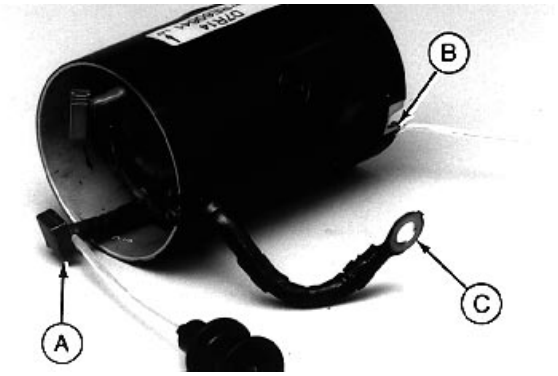
A—Commutator
B—Shaft

RG,RG34710,2392 –19–15MAR97–1/1

Testing Field Winding

1. Check insulation by connecting an ohmmeter between brush (A) and field frame (B). If ohmmeter indicator swings toward zero, a grounded circuit is indicated.
2. Connect ohmmeter between brush (A) and terminal (C). Resistance should be below 1 ohm.
3. If defective, replace the complete starter motor.

A—Brush
B—Field Frame
C—Field Frame Terminal



Test Field Winding

RG,RG34710,2393 –19–15MAR97–1/1

Checking Overrunning Clutch Pinion

1. Check for pinion tooth condition. Slight damage on teeth can be eliminated by grinding.

NOTE: Damage on teeth can be caused by a malfunction of electrical system. Also check electrical circuit for proper operation (switch, relay etc.).

2. Turn overrunning clutch pinion by hand. Clutch pinion should turn freely on shaft in overrunning direction only.

3. If defective, replace overrunning clutch pinion.

NOTE: Overrunning clutch pinion is available as a John Deere service part.

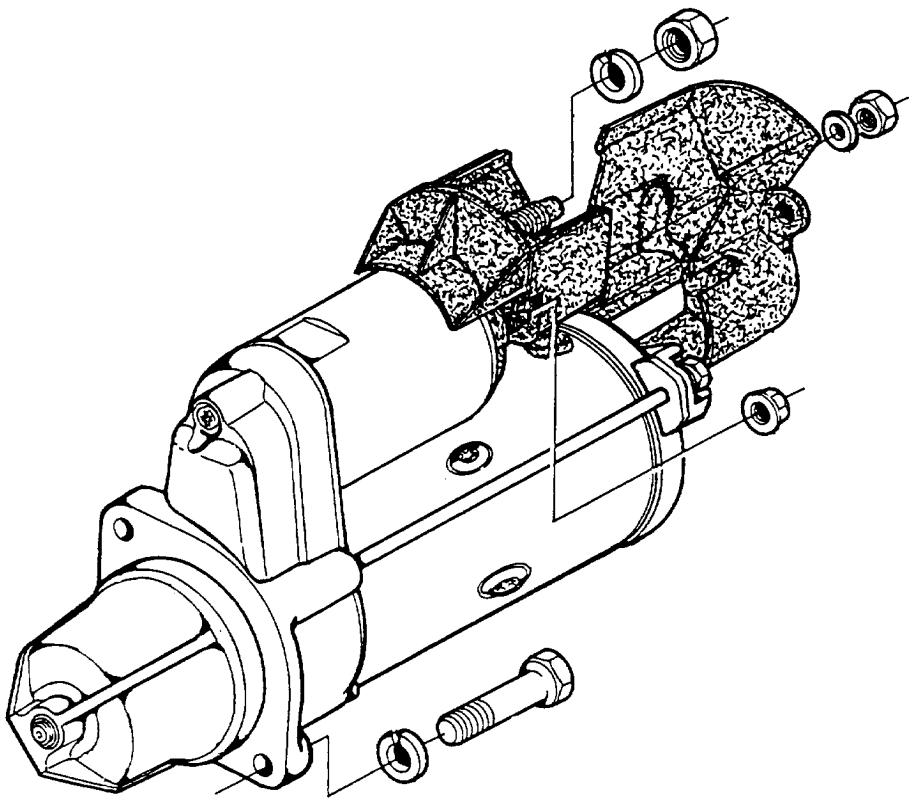
CD30468 –UN–22JUL96

Check Overrunning Clutch Pinion

RG,RG34710,2394 –19–12SEP02–1/1

80
10
12

Reassembly of Starter Motor



CD30469 –UN–17JUL96

Reassemble Starter Motor

Reassemble starter motor in the reverse sequence of disassembly procedure.

Use petroleum-base grease to lightly coat mechanical part assemblies such as shaft in nose bushing, gear reduction train, overrunning clutch pinion on shaft, and shaft rear bearing.

Refer to machine technical manual to install starter motor and adjust belt tension.

Item	Measurement	Specification
Starter Solenoid Mounting Cap Screws	Torque	3 N•m (27 lb-in.)
Housing Through Bolts	Torque	7 N•m (62 lb-in.)
Field Winding Terminal Screw	Torque	10 N•m (88 lb-in.)

RG,RG34710,2396 –19–15MAR97–1/1

Section 85
Magneton Starter Motors

Contents

General Information

IMPORTANT: Never operate starter motor longer than 5 seconds. Allow at least 20 seconds for cooling and battery recovery before operating again. Overheating caused by excessive operation will seriously damage starter motor.

CD03523,00000D5 –19–30JUL02–1/1

Typical Starting Circuit Operation

When wire from relay (A) is energized, current flows through both pull-in winding (C) and hold-in winding (D) to ground.

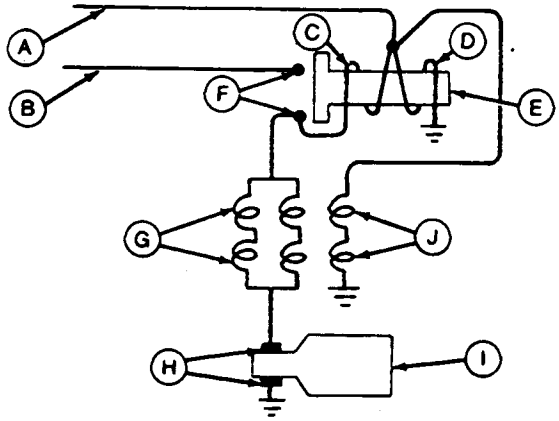
Current through windings engages solenoid plunger (E), which closes main contacts (F). When main contacts close, current through pull-in windings stops. Current continues through hold-in winding, keeping solenoid engaged and main contacts closed.

With main contacts closed, current flows from battery cable (B) to starter motor at a very high rate. Four heavy field windings (G) carry current to commutator brushes (H).

Light shunt windings (J) are wrapped together with two of the heavy field windings. Shunt windings are connected to solenoid switch terminal and directly to ground. They provide additional low speed torque to assist engine rotation and prevent overspeeding of motor.

From field windings, current flows through armature windings (I) to ground, making contact through commutator brushes (H).

Strong magnetic fields are set up by current flow through field windings and armature windings. Windings are arranged so that magnetic fields constantly repel each other, rotating armature.



RG1313 –UN–20APR89

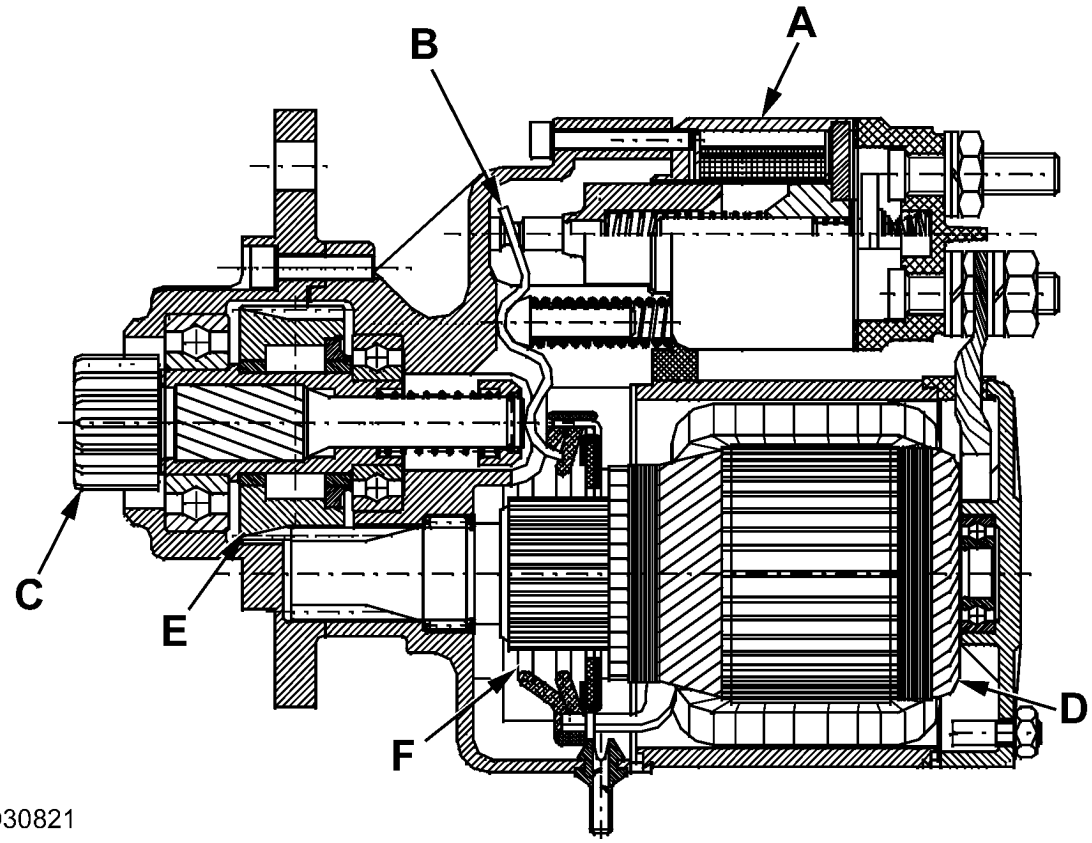
Typical Starting Circuit Operation

A—Wire From Relay
B—Cable from Battery
C—Pull-In Winding
D—Hold-In Winding
E—Solenoid Plunger
F—Main Contacts
G—Field Windings
H—Commutator Brushes
I—Armature
J—Shunt Windings

85
05
1

CD03523,00000D6 –19–17JUL02–1/1

Starter Motor Operation



Magneton Starter Operation

A—Solenoid assembly
B—Shift lever
C—Overrunning clutch drive
D—Armature
E—Clutch drive external gear
F—Brushes

When solenoid (A) engages, it pulls shift lever (B). Lever pushes overrunning clutch drive (C) to engage pinion in starter gear on flywheel. As armature (D) turns, it cranks engine.

When engine starts, overrunning clutch spins freely on shaft. This prevents overspeeding of armature by flywheel.

When key switch is released, current to solenoid hold-in winding is shut off. Current can feed through both pull-in and hold-in windings from main contacts, but direction of current is reversed in pull-in winding. The two windings cancel each other, and solenoid is released.

A spring pushes solenoid back to disengaged position. This opens main contacts and shuts off current to field windings and armature.

Shift lever retracts overrunning clutch drive, disengaging pinion from flywheel.

In this reduction-type starter, the speed of armature rotation is reduced by the external gear (E) of the clutch drive.

85
05
2

CD03523,00000D7 –19–29JUL02–1/1

Essential Tools

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000BAB –19–08MAY02–1/3

Digital Multimeter JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.

RW11274 –UN–12DEC88

JT05791

OUO1004,0000BAB –19–08MAY02–2/3

85
10
1

Alternator, Generator, Starter and Battery Bench Tester. JT01760

Test alternators and starters for voltage, resistance, or current flow.

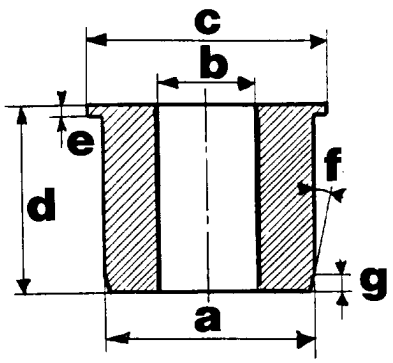
OUO1004,0000BAB –19–08MAY02–3/3

Dealer Fabricated Tools

Dummy Commutator for Brush Holder Removal and Installation

Material: Plastic

a—Dia. 36.4—36.6 mm (1.433—1.441 in.)
b—Dia. 24.5 mm (0.96 in.)
c—Dia. 42 mm (1.65 in.)
d—35 mm (1.38 in.)
e—2.5 mm (0.10 in.)
f—Chamfer 15°
g—2.5 mm (0.10 in.)



CD30494 –UN–31JAN97

Dummy Commutator for Brush Holder

CD03523,00000D4 –19–17JUL02–1/1

Magneton Starter Motor Repair Specifications

Item	Measurement	Specification
New Brush	Length	18 mm (0.71 in.)
Used Brush	Minimum Length	7.5 mm (0.30 in.)
Solenoid Switch Screws	Torque	4 N•m (35 lb-in.)
Rear Cover Nut	Torque	6 N•m (53 lb-in.)
Field Winding Terminal Nut	Torque	7 N•m (62 lb-in.)
Front Flange Screw	Torque	7 N•m (62 lb-in.)
Terminal nut (from battery)	Torque	15 N•m (11 lb-ft)
Terminal nut (from relay)	Torque	2 N•m (17 lb-in.)

85
10
2

CD03523,00000D8 –19–17JUL02–1/1

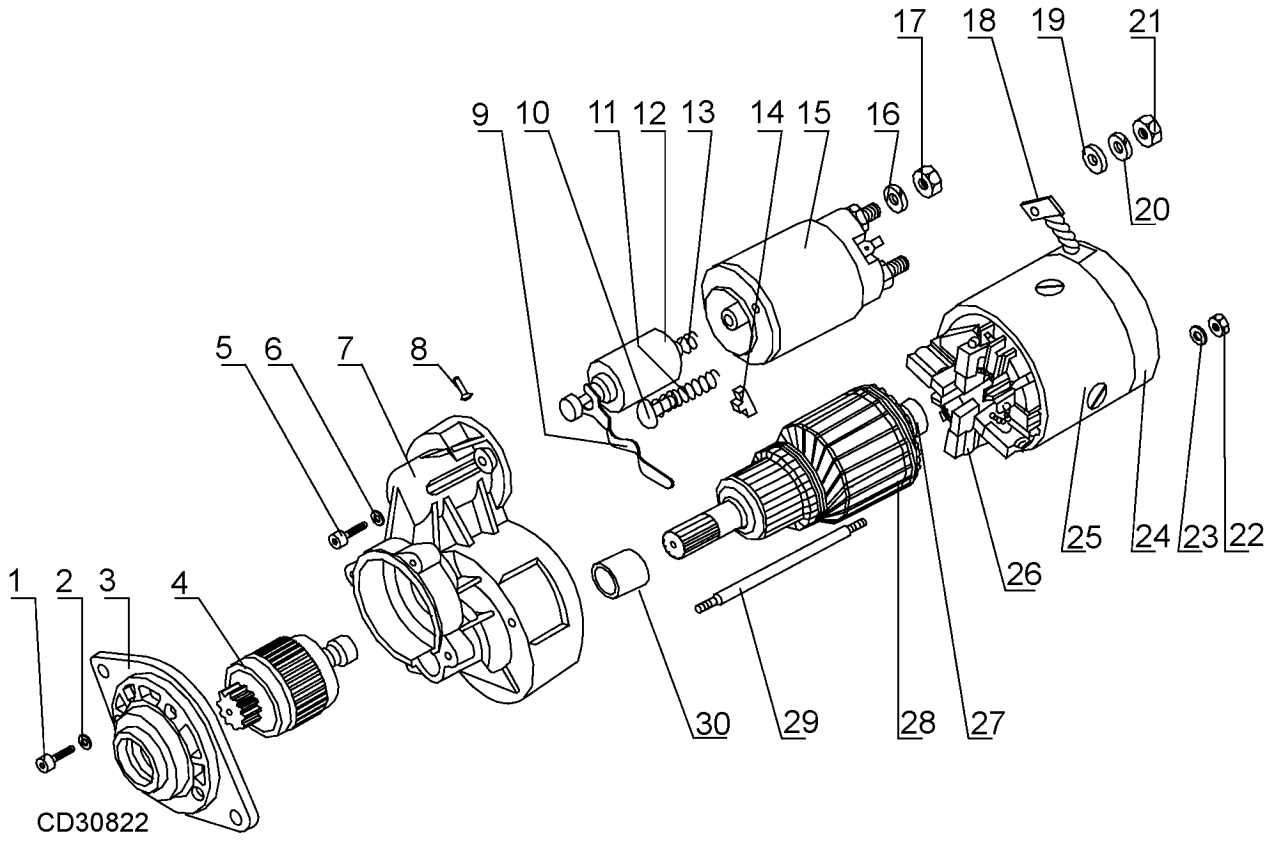
Magneton Starter Motor Test Specifications

				Solenoid Current		Pinion	
John Deere Starter Motor Part Number	Magneton Starter Motor Part Number	System Voltage	Rating (kW)	Pull-In Winding (Amps)	Hold-In Winding (Amps)	No. of Teeth	Tooth Spacing (Modul)
RE507236	9142 740	12	2.7	65	20	10	3.175

CD03523,00000D9 –19–07JUL05–1/1

85
10
3

Exploded View of Starter Motor



CD30822 –UN–26JUL02

Exploded view

1—M6x25 Screw
2—Lock Washer
3—Front Flange/Ball Bearing Housing
4—Overrunning Clutch Pinion[1]
5—M5x35 Screw
6—Lock Washer
7—Transmission Housing
8—Vent Pipe
9—Shift Lever
10—Pivot
11—Pivot Spring
12—Plunger
13—Plunger Spring
14—Sealing
15—Solenoid Body[1]
16—Lock Washer
17—M10 Nut
18—Field Winding Cable
19—Washer
20—Lock Washer
21—M8 Nut
22—M6 Nut
23—Lock Washer
24—Rear Cover
25—Stator
26—Brush Holder[1]
27—Ball Bearing
28—Armature
29—Housing Through Stud
30—Roller Bearing

85
10
4

[1]Available as service parts.

CD03523,00000DA –19–29JUL02–1/1

Identification

The information for part identification is located on the body of the starter motor as shown.

CD30823 –UN–26JUL02

Identification

CD03523,00000DB –19–29JUL02–1/1

Troubleshooting

Symptom	Problem	Solution
Fails to operate, no current draw	Open field circuit	Replace starter motor
	Open armature windings	Replace starter motor
	Defective brush contact with commutator	Clean brush holder or replace brushes
	Open solenoid windings	Replace solenoid
	Defective solenoid contact	Replace solenoid
Fails to operate, high current draw	Grounded field windings or armature windings	Replace starter motor
	Seized bearings	Replace starter motor
Low speed, low current draw	High internal resistance	Replace starter motor
	Defective brush contact with commutator	Clean brush holder or replace brushes
Low speed, high current draw	Shorted armature	Replace starter motor
	Grounded armature or field windings	Replace starter motor
High speed, high current draw	Shorted field windings	Replace starter motor
Solenoid switch operates but armature does not rotate	Worn or broken brushes	Clean brush holder and commutator and replace brushes
	Shorted field windings	Replace starter motor
Solenoid quickly engages and disengages	Shorted hold-in windings	Replace solenoid
Starter motor spins, but does not crank the engine	Overrunning clutch slipping	Replace overrunning clutch
	Pinion does not move into mesh with the gear ring	Replace engaging lever or clutch

85
10
6

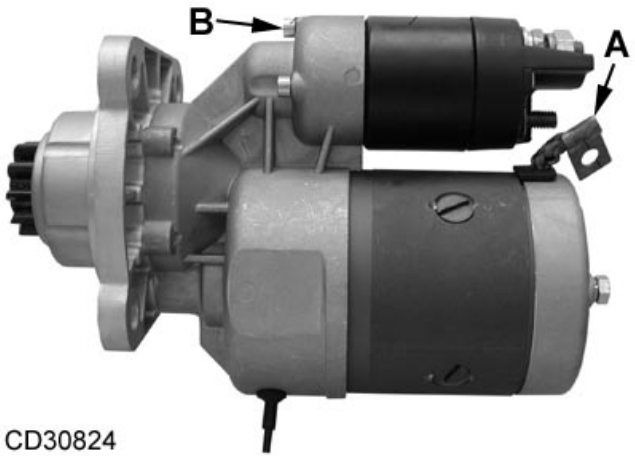
RG,RG34710,2373 –19–15MAR97–1/1

Disassembly of Starter Motor

NOTE: Before separating, mark parts so that they can be reinstalled in their original positions.

1. Disconnect field winding cable (A).
2. Remove the three screws (B) holding the solenoid switch.

A—Field Winding Cable
B—Screw (3 used)

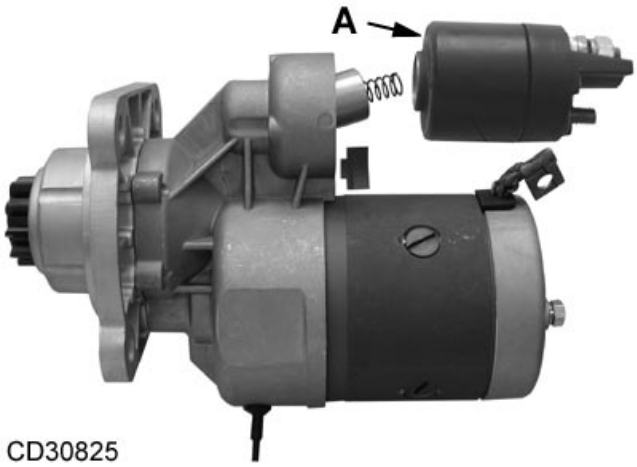


Unfasten Solenoid Switch

CD03523,00000DC –19–27AUG02–1/9

3. Remove solenoid switch (A).

A—Solenoid Switch



Remove Solenoid Switch

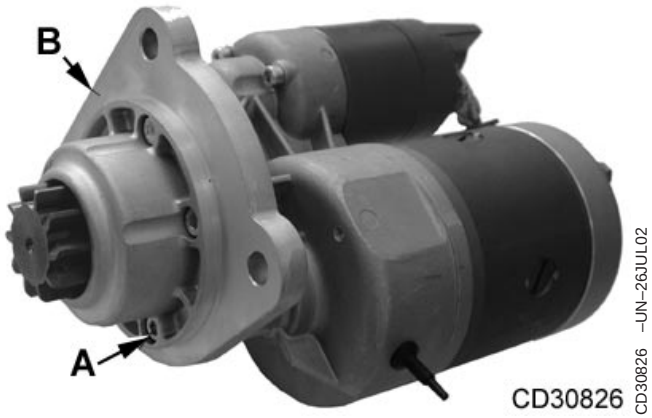
85
10
7

Continued on next page

CD03523,00000DC –19–27AUG02–2/9

4. Unscrew the four screws (A) holding the front flange (B)

A—Screw
B—Front Flange

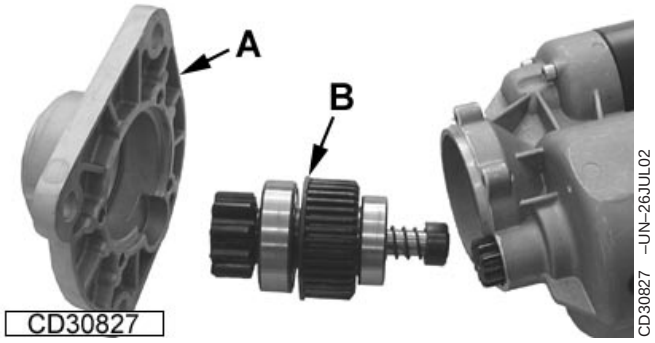


Remove Screws

CD03523,00000DC –19–27AUG02–3/9

5. Separate front flange (A) and overrunning clutch assembly (B) from transmission housing.

A—Front Flange
B—Overrunning Clutch Assembly



Remove Overrunning Clutch

CD03523,00000DC –19–27AUG02–4/9

85
10
8

6. Unscrew nuts (A).

A—Nut (2 used)

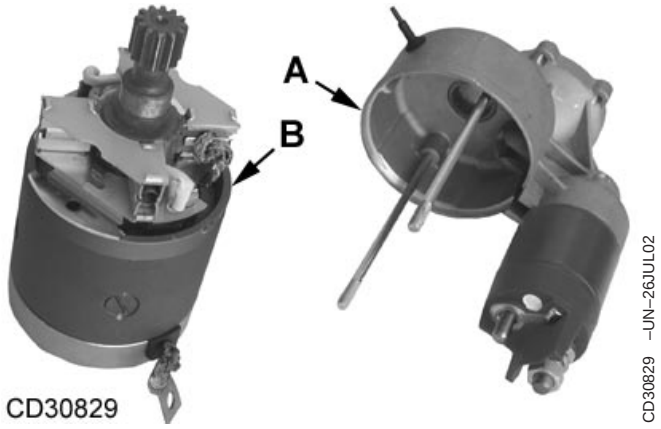
Remove Nuts

Continued on next page

CD03523,00000DC –19–27AUG02–5/9

7. Separate transmission cover (A) from stator/armature (B).

A—Transmission Cover
B—Stator/Armature Assembly

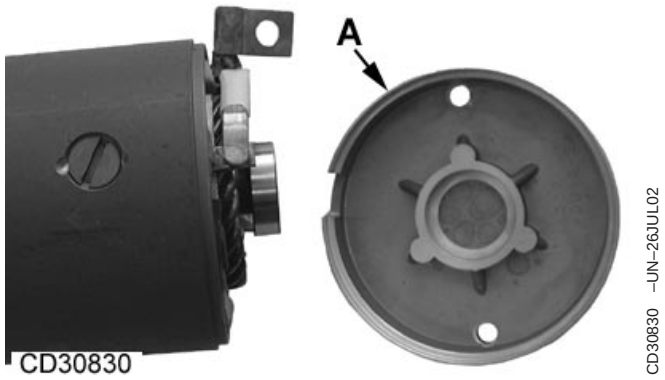


Remove Transmission Cover

CD03523,00000DC –19–27AUG02–6/9

8. Remove the rear cover (A).

A—Rear Cover



Remove Rear Cover

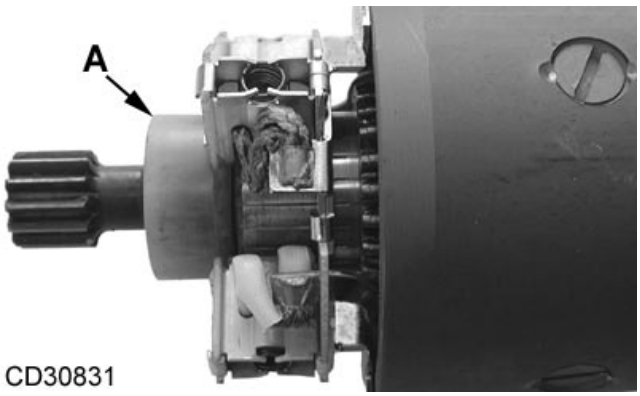
85
10
9

Continued on next page

CD03523,00000DC –19–27AUG02–7/9

9. Install a dummy commutator (A) as shown in Dealer Fabricated Tools earlier in this group.

A—Dummy Commutator

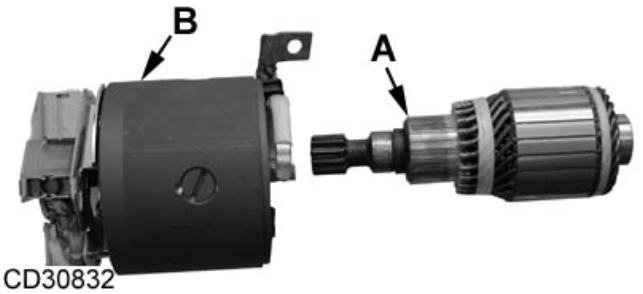


Install Dummy Commutator

CD03523,00000DC –19–27AUG02–8/9

10. Separate armature (A) from stator (B).

A—Armature
B—Stator



Remove Armature

CD03523,00000DC –19–27AUG02–9/9

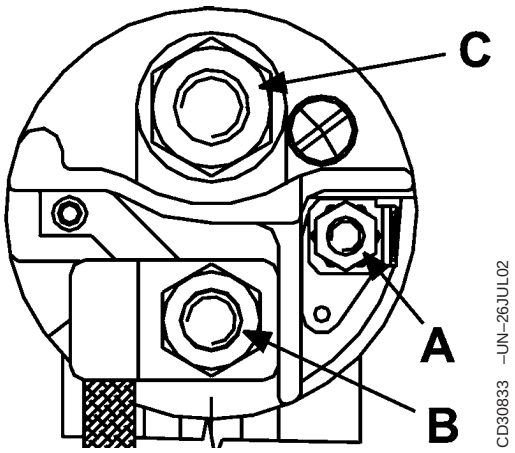
85
10
10

Testing Solenoid Switch

1. Check for continuity between solenoid terminal (A) and motor terminal (B). If there is no continuity, replace the solenoid switch. (Resistance should be approximately 0.3 ohms.)

2. Check for continuity between solenoid terminal (A) and the steel casing. If there is no continuity, replace the solenoid switch. (Resistance should be approximately 0.9 ohms.)

3. Perform this test with the plunger and spring in the solenoid body. Prevent the plunger from falling out after disconnecting power. Apply appropriate voltage (12 volts or 24 volts) between solenoid terminal (A) and the steel casing. Connect a ground wire capable of 60 amps between motor terminal (B) and the steel casing. The plunger should pull in. Disconnect the ground wire, and the plunger should remain held in. Connect the ohmmeter between terminals (B) and (C). There should be continuity only when the plunger is held in. Disconnect power, and the pinion plunger should extend. If any test above fails, replace the solenoid switch.



Testing Solenoid Switch

A—Solenoid Terminal
B—Motor Terminal
C—Battery Terminal

CD03523,00000DD –19–29JUL02–1/1

85
10
11

Testing Brushes

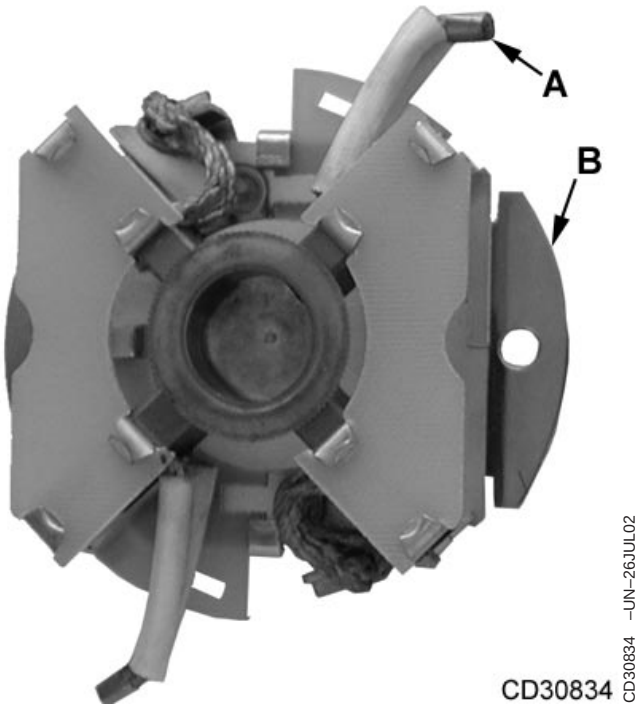
1. Check positive brush holder by connecting an ohmmeter between brush lead (A) and ground plate (B). If the resistance is not infinity, replace brush holder.

2. Inspect brushes. Brushes must move freely in their guides. Check brush overall length. Replace brush holder if brushes are frozen or too worn.

Specification

New Brush—Length ..... 18 mm (0.71 in.)
Used Brush—Minimum Length ..... 7.5 mm (0.30 in.)

A—Positive Brush Lead
B—Ground Plate



Testing Brushes

CD03523,00000DE –19–29JUL02–1/1

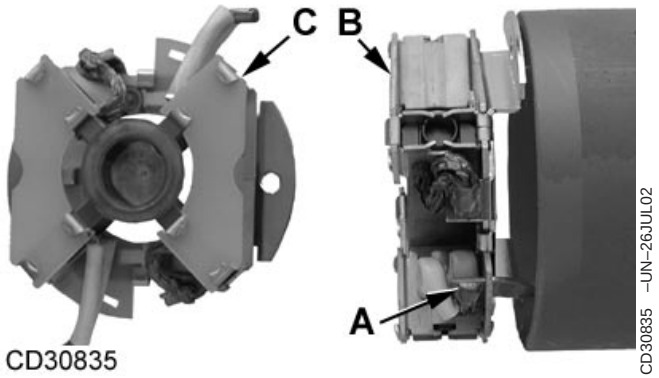
Brush Holder Replacement

1. Cut off old brushes at end of brush stranded wire (A).

2. Solder new brush wire using a 40—60% tin-lead mix. Heat to 230°C (446°F).

NOTE: This operation needs a specialized tooling. Eventually, have the brush holder replaced by a local electrical repair station.

A—Brush Stranded Wire
B—Old Brush Holder
C—New Brush Holder

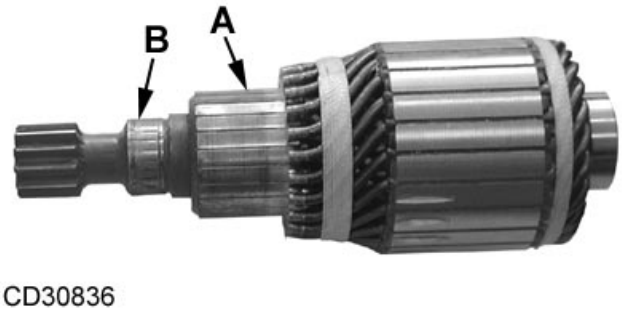


Brush Holder Replacement

CD03523,00000DF –19–27AUG02–1/1

Testing Armature

1. Check the armature insulation by connecting an ohmmeter between the commutator (A) and the shaft (B). If test shows continuity (needle movement), the armature is grounded.
2. Check for armature condition. Space between bars must be clean and of even depth. Small defects can be eliminated using sandpaper and a lathe.
3. If insulation is defective or armature is quite worn, replace the complete starter motor.



Testing Armature

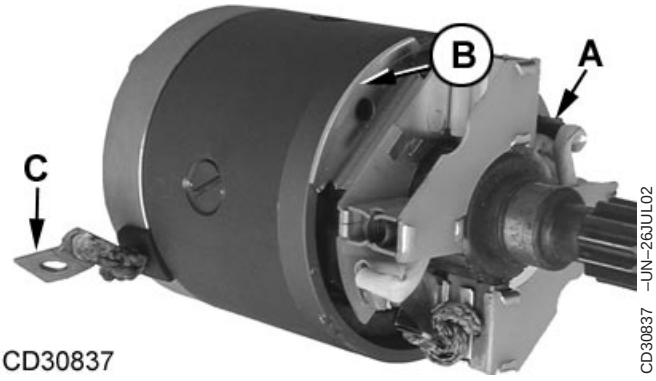
A—Commutator
B—Shaft

RG,RG34710,2392 –19–29JUL02–1/1

Testing Field Winding

Connect ohmmeter between positive brush (A) and field winding cable (C). Resistance should be below 1 Ohm. If defective, replace complete starter motor.

A—Brush
B—Brush Holder
C—Field Frame Cable



Testing Field Winding

85
10
13

CD03523,00000E0 –19–29JUL02–1/1

Checking Overrunning Clutch Pinion

1. Check for pinion tooth condition. Slight damage to teeth can be eliminated by grinding.

NOTE: Damage to teeth can be caused by a malfunction of electrical system. Also check electrical circuit for proper operation (switch, relay etc.).

2. Turn overrunning clutch pinion by hand. Clutch pinion should turn freely on shaft in overrunning direction only.

3. If defective, replace the overrunning clutch pinion assembly.

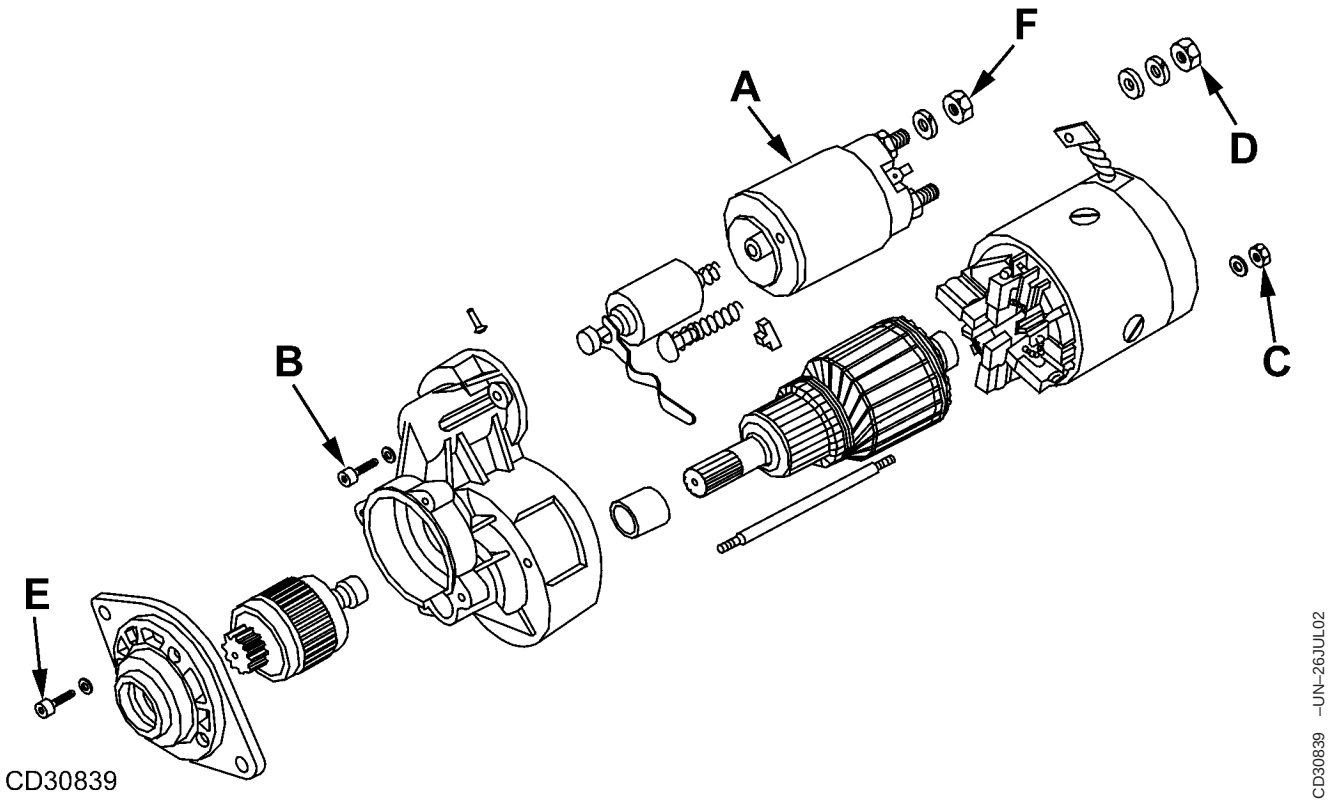
CD30838 –UN–29JUL02

Checking Overrunning Clutch Pinion

CD03523,00000E1 –19–29JUL02–1/1

85
10
14

Reassembly of Starter Motor



Reassembly of Starter Motor

A—Solenoid Switch
B—Solenoid Switch Screw
C—Rear Cover Nut
D—Field Winding Terminal Nut
E—Front Flange Screw
F—Terminal (from battery) Nut

Reassemble starter motor in the reverse sequence of disassembly procedure. It is recommended to assemble solenoid switch (A) with transmission housing first.

Apply sealing compound on contact surface and on threads of cap screws.

Use petroleum-base grease to lightly coat mechanical part assemblies such as shaft in front bearing, gear reduction train, overrunning clutch pinion on shaft, and shaft rear bearing.

Refer to machine technical manual to install starter motor on engine.

85
10
15

Item	Measurement	Specification
Solenoid Switch Screws (B)	Torque	4 N•m (35 lb-in.)
Rear Cover Nuts (C)	Torque	6 N•m (53 lb-in.)
Field Winding Terminal Nut (D)	Torque	7 N•m (62 lb-in.)
Front Flange Screws (E)	Torque	7 N•m (62 lb-in.)

Continued on next page

Item	Measurement	Specification
Terminal (from battery) Nut (F)	Torque	15 N•m (11 lb-ft)
Terminal (from relay) Nut	Torque	2 N•m (17 lb-in.)

CD03523,00000E2 –19–30JUL02–2/2

Index

Indx 1