Section 240
ELECTRICAL OPERATION AND TESTS

CONTENTS OF THIS SECTION

Group 00
SPECIFICATIONS AND SPECIAL TOOLS

SPECIFICATIONS

GENERAL INFORMATION	
Battery Requirement	400 to 600 amps
Fuses	
Key switch circuit	MDL-25 amp
Magnetic switch circuit ("D" engines)	SFE-14 amp
Rack puller circuit ("T" and "A" engines)	SFE-20 amp
Magnetic switch	
Winding current draw at 12 volts	1.6-1.8 amps
Injection pump solenoid ("D" engines)	
Winding current draw at 12 volts	2.5 amps
Injection pump rack puller ("T" and "A" engines)	
Winding current draw at 12 volts	2.4 amps
CHARGING CIRCUIT	
Wiring test (Motorola Alternators)	
Negative battery post-to-alternator ground terminal voltage drop	No more than 0.3 volts
Positive battery post-to-alternator output terminal voltage drop	No more than 0.3 volts
Positive battery post-to-Alternator voltage regulator terminal voltage drop	No more than 1.3 volts
Motorola alternator output test	
35 amp alternator	25 amps minimum
55 amp alternator	45 amps minimum
72 amp alternator	65 amps minimum

CHARGING CIRCUIT—Continued

Delcotron alternator voltage checks	
"BAT" Terminal	Battery voltage
Red wire to No. 2 terminal	Battery terminal
Voltage rise at "BAT" terminal (engine running/engine stopped)	0.5 volts minimum
AC voltage ripple at No. 1 terminal (engine running)	0.4 volts maximum
Regulated voltage at "BAT" terminal after 15 minutes operation:	

Air Temperature 1 in. (25 mm) Behind Regulator Case	Voltage
85°F (29°C)	13.8-14.9 volts
105°F (41°C)	13.6-14.7 volts
125°F (52°C)	13.4-14.6 volts
145°F (63°C)	13.2-14.4 volts

Optional Delcotron alternator output test	
35 amp alternator	30 amps minimum
55 amp alternator	45 amps minimum
72 amp alternator	60 amps minimum

SPECIAL TOOLS

R 28793N

Fig. 1-D-24001MO Battery Tester

TOOL	USE
D-24001MO Battery Tester	**Test battery**

R 28795N

Fig. 2-D-19001TT Volt-Ohm-Amp Meter

D-19001TT Volt-Ohm-Amp Meter	**Test any electrical component for voltage, resistance or current draw.**

Group 05
GENERAL INFORMATION AND DIAGRAMS

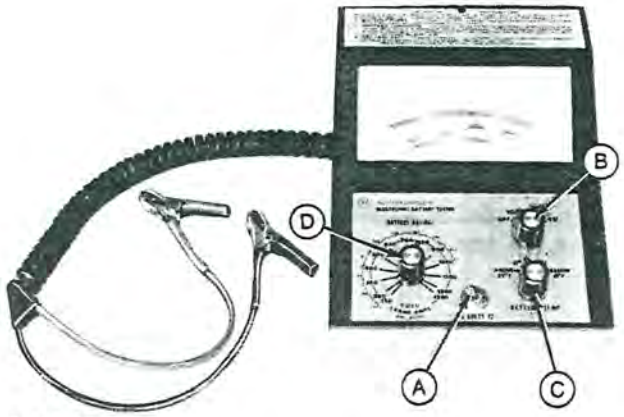
GENERAL DIAGNOSIS

Testing Battery

When diagnosing an engine for any electrical problem, regardless of the complaint, test the battery first. Battery condition is vitally important to every part of the electrical system.

1. Inspect battery. Check for a cracked, damp or dirty case. (Case should be clean and dry to prevent surface discharge.) Check for loose or corroded terminals and correct as necessary.

2. Check electrolyte level in each cell. Add clean, mineral-free water if necessary to bring level to bottom of filler neck.



R 28815N

A—Battery Voltage Switch
B—Selector Switch
C—Temperature Switch
D—Battery Rating Switch

Fig. 1-D-24001MO Battery Tester

3. Connect D-24001MO Battery Tester, with red clip to positive terminal and black clip to negative terminal.

4. Set toggle switch (A, Fig. 1) on 12 volts and turn selector switch (B) to "VOLTS". Check battery voltage. It should be 12.4 to 13.0 volts.

5. If voltage is too high, crank engine for 15 seconds without starting to remove surface charge from battery. Recheck voltage.

6. If voltage is too low, recharge battery. Then recheck voltage.

7. If voltage is correct, check battery condition. Turn temperature switch (C) to estimated battery temperature. Turn battery rating switch (D) to 800. Turn selector switch to "BAT COND" and read battery condition.

8. If tester indicates "REPLACE", disconnect battery cables and recheck. Problem might be due to a poor connection.

Checking Fuses

If none of the electrical system is functioning, check the fuse in the fuseholder between the ammeter and the key switch. If defective, replace with an MDL-25 fuse.

On "D" stationary engines and 6466 "T" and "A" stationary engines equipped with an RP-75 Rack Puller, check the fuse mounted on the bottom of the magnetic switch. If defective, install a new SFE-14 fuse.

On "T" and "A" stationary engines equipped with an RP-20 Rack Puller, check the fuse in the fuseholder between the ammeter and the rack puller. If defective, install a new SFE-20 fuse.

Checking Key Switch

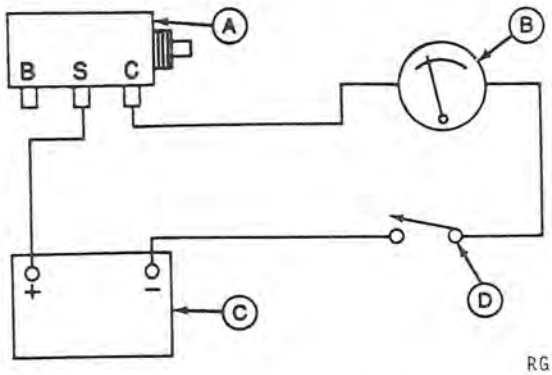
Check key switch terminals for continuity as directed on page 40-05-01.

Checking Magnetic Switch (Stationary Engines)

A magnetic safety switch is installed on "D" engines and late 6466 "T" and "A" engines with an RP-75 Rack Puller. This switch activates the injection pump shut-off solenoid ("D" engines) or the RP-75 Rack Puller (Late 6466 "T" and "A" engines) if engine oil pressure goes below 15 psi (1.05 bar) (1.05 kg/cm²) or if coolant temperature rises above 220°F (104°C).

GENERAL DIAGNOSIS—Continued

Checking Magnetic Switch—Continued



A—Magnetic Switch
B—Ammeter
C—12 Volt Battery
D—Switch

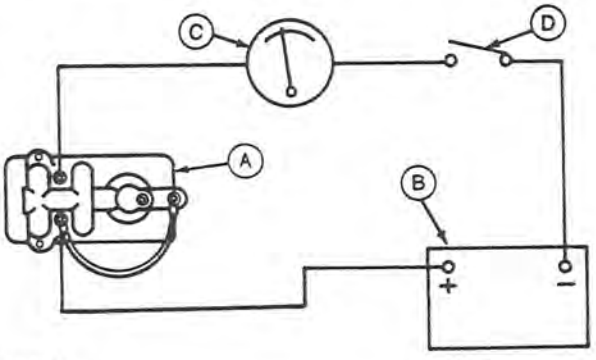
Fig. 2-Testing Magnetic Switch

To check magnetic switch, disconnect and tag all wiring for reassembly. Make connections as shown in Fig. 2.

Close switch (D, Fig. 2) and observe ammeter. Switch coil should draw 1.6 to 1.8 amps at 12 volts.

Checking Injection Pump Solenoid

If a "D" engine will not start and all other systems are operating correctly, check the solenoid on the fuel injection pump.



A—Injection Pump Cover
B—12 Volt Battery
C—Ammeter
D—Switch

Fig. 3-Testing Injection Pump Solenoid

To check the solenoid, make the connections shown in Fig. 3.

Close switch (D, Fig. 3) and observe ammeter. Current draw should be about 2.5 amps at 12 volts.

High current draw indicates shorted solenoid windings.

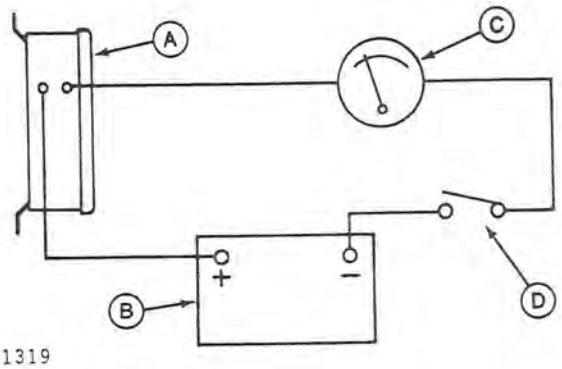
Low or no current draw indicates a high resistance connection, either internal or external, or open windings in the solenoid.

Refer to Section 30, Group 15 for repair procedure.

Checking Rack Puller—RP-20 Rack Puller (Stationary Engines)

If a "T" or "A" engine with an RP-20 Rack Puller will not start, and all other systems are operating properly, check the rack puller.

Disconnect wiring at rack puller and make connections shown in Fig. 4.



A—Rack Puller Terminals
B—12 Volt Battery
C—Ammeter
D—Switch

Fig. 4-Testing RP-20 Rack Puller

Close switch (D, Fig. 4) and observe ammeter (C).

If rack puller has been reset (handle pulled down to locked position), current draw should be 2.4 amps at 12 volts.

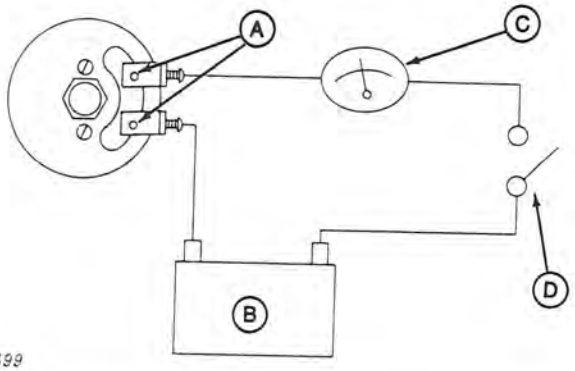
If rack puller has not been reset, there should be no current draw.

If rack puller fails either test, either switch or solenoid inside rack puller is defective. Refer to Section 30, Group 15 for repair procedure.

RP-75 Rack Puller (Stationary Engines)

If a 6466 "T" or "A" engine with an RP-75 Rack Puller will not start, and all other systems are operating properly, check the rack puller.

Disconnect wiring at rack puller and make connections shown in Fig. 5.



RG1399

A—Rack Puller Terminals **C—Ammeter**
B—12-Volt Battery **D—Switch**

Fig. 5-Testing RP-75 Rack Puller

Close switch (D, Fig. 5) and observe ammeter (C).

Rack puller should draw 0.4 amps at 12 volts. As an additional test, check resistance of the solenoid with an ohmmeter. A good coil should have about 30 ohms resistance.

Refer to Section 30, Group 15 for repair procedure.

Group 10
CHARGING CIRCUIT DIAGNOSIS

GENERAL INFORMATION

NOTE: See Section 40, Group 10 for Motorola charging circuit repair. See Group 15 for Delcotron charging circuit repair.

John Deere engines may be equipped with a Motorola or Delcotron charging system. The various alternators used are listed below. All are 12 volt.

Motorola Alternators

Series	Amps	Stator Connection
RA	35	"Y"
RA	55	"Delta"
MR	72	"Delta"

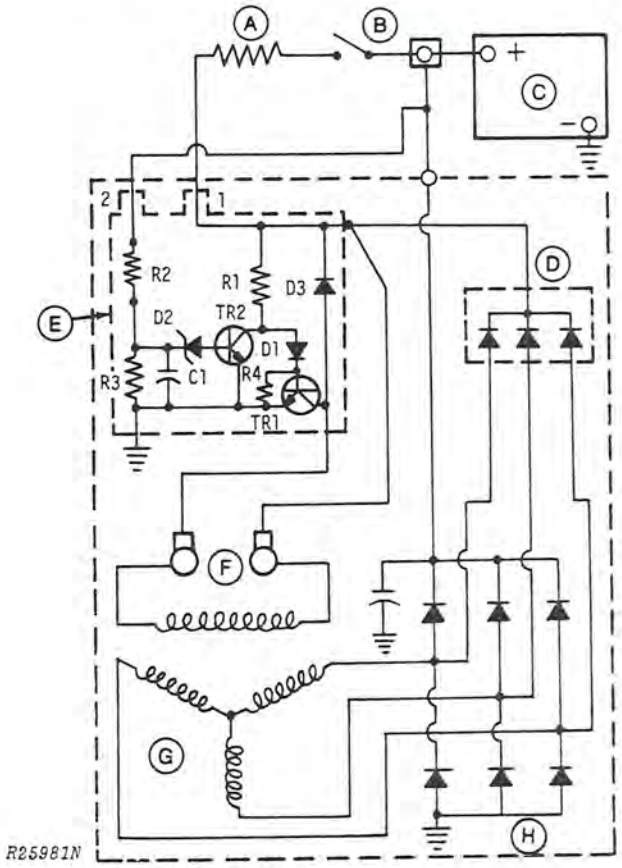
Delcotron Alternators

Amps	Stator Connection
37	"Y"
55	"Y"
61	"Y"
72	"Delta"

Alternators are equipped with a solid-state, sealed and non-adjustable voltage regulator. The regulator is mounted internally on Delcotron alternators and is mounted externally on Motorola alternators.

HOW THE SYSTEM WORKS

NOTE: This section discusses operation of the Delcotron alternator. Operation of the Motorola alternator is similar.



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

Fig. 1-Schematic Diagram of Delcotron Alternator

Fig. 1 illustrates circuitry of alternator. Schematic of regulator is simplified somewhat. Regulator actually contains many more components than shown, but performs the same function.

NOTE: Resistance is extremely high in resistor R3, preventing battery run-down. It does allow a constant drain on battery, but drain is insignificantly small—only a few milliamps. Resistors R3 and R4 are needed to provide the voltage differential required to turn transistors on.

OPERATION—Continued

In an alternator (unlike a DC generator) the magnetic field rotates, and windings are stationary.

Magnetic field is externally excited, meaning it requires an outside current source. Rotor consists of two interlocking soft iron sections and a wire coil wrapped around an iron core. When current is passed through wire coil, rotor becomes an electromagnet.

Rotating magnetic field induces alternating current in stator windings. This is converted to direct current by six diodes in rectifier bridge.

A capacitor inside rear housing protects rectifier bridge and diode trio 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.

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

Phase I—Alternator Stopped

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

1. Current flows from battery through key switch and resistance wire to terminal 1.

2. From there, current flows through resistor R1 to transistor TR1 and turns it on.

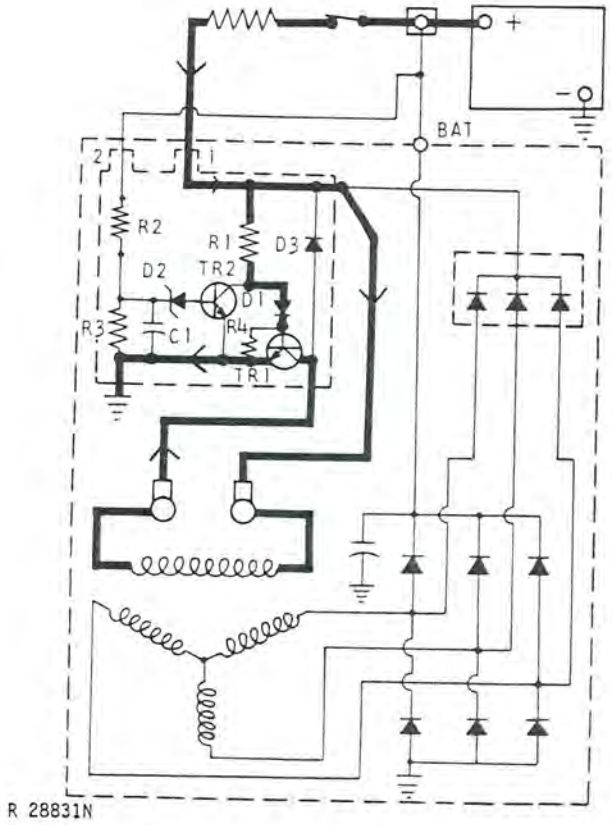


Fig. 2-Regulator in Phase I (Alternator Stopped)

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.

Phase II—Generating Electricity

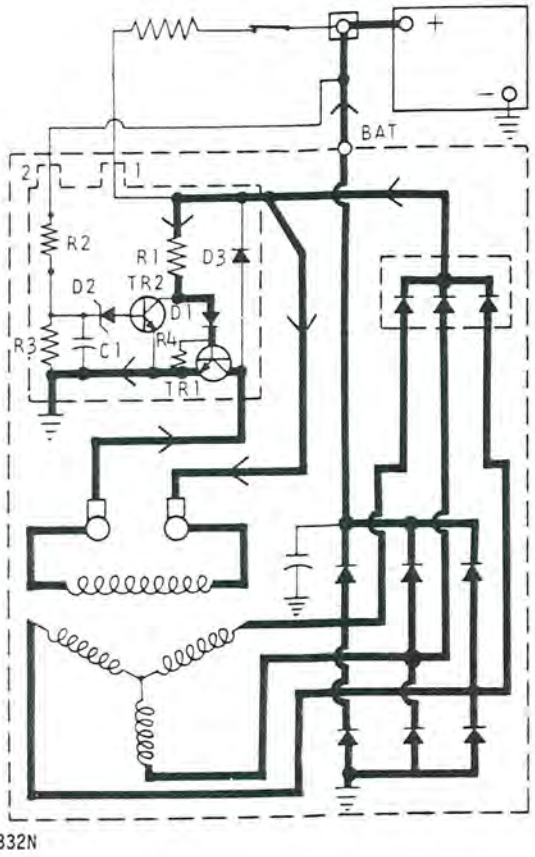


Fig. 3-Regulator in Phase II (Generating Electricity)

1. Diode trio, key switch, rectifier bridge, and terminal 1 all have equal voltage. Therefore no current flows through resistance wire.

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 field is rotating, it does indeed generate electricity. Alternating current is induced in stator windings. 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.

Phase III—Shut-Off

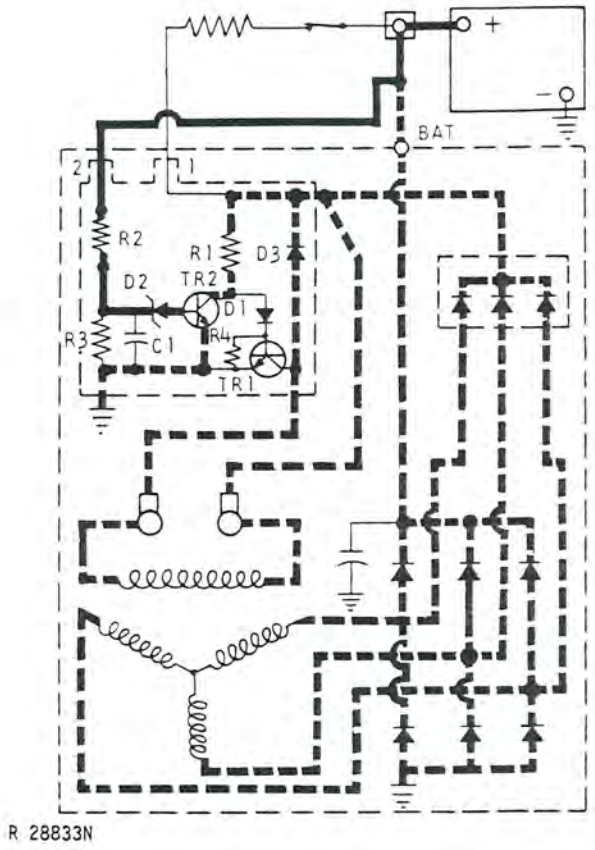


Fig. 4-Regulator in Phase III (Shut-Off)

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. Phases II and III are repeated many times per second to maintain voltage at proper level.

PRECAUTIONS

When working on charging circuit, observe the following rules for your safety and prevention of damage to engine:

Safety

1. Keep all sparks and flames away from batteries. Gas from battery electrolyte is highly flammable. Also avoid spilling electrolyte on yourself or on anything which could be damaged by the sulphuric acid.

2. Avoid sparks when connecting booster batteries or battery chargers. When possible, make last connection at a point away from batteries. Battery charger should be turned off before connecting or disconnecting.

3. When connecting batteries, always connect ground cable last. Disconnect it first.

4. When possible, disconnect battery ground cable before working on electrical system.

Prevention of Damage

1. Before connecting battery cables, be sure that battery and alternator connections are correct. Reverse polarity can cause permanent damage.

2. When connecting a booster battery, connect positive terminal of booster battery to positive terminal of engine battery. Then connect negative terminal of booster battery to engine frame. Reverse polarity can cause permanent damage.

3. Never run engine with alternator or battery cables disconnected. Doing so might damage alternator or regulator.

4. Never short across or ground alternator terminals unless specifically recommended. Be careful to prevent grounding alternator wires when disconnected.

5. Never attempt to polarize an alternator.

DIAGNOSIS AND TESTS

1. First, see whether alternator is charging at all. Simply observe ammeter in instrument panel. Note position of needle with key switch on and engine stopped, then start engine and note position. If alternator is charging, needle will register higher with engine running.

2. Before testing alternator itself, see if problem is somewhere else.

-Check for loose or worn alternator belts. If either belt is bad, replace both as a matched set.

-Ask how engine is used. Problem might be frequent starting, with too little running to recharge batteries.

-Test batteries as instructed on page 1 of Group 05.

-Check for a slow drain on batteries. With all switches off, disconnect battery ground cable and connect a sensitive ammeter between cable and battery post. If current exceeds 100 milliamps, see where it is going. Unplug connectors one at a time until you locate the circuit, then try to find the problem.

-Check entire charging circuit for a poor connection. Problem could be at batteries, starter, starter circuit relay, key switch, or alternator.

Testing Motorola Alternators Wiring Test

Obtain a 10-amp charge rate. Use a pin connector at a battery post. The voltage drop from the grounded battery post to the alternator ground terminal should be 0.3 volt or less. From the positive battery post to the alternator output terminal the voltage drop should be less than 0.3 volt. There should be 1.3 volts or less from the positive battery post to the alternator regulator terminal.

High resistances are usually caused by a poor connection.

Testing Alternator and Regulator With Voltmeter

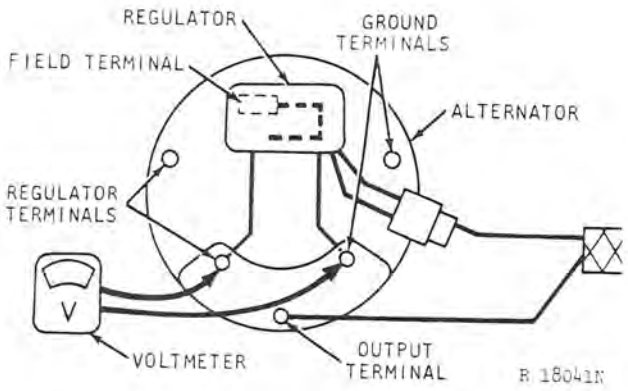


Fig. 5-Voltmeter Connected to Regulator Terminal

1. With key switch off, connect voltmeter (Fig. 5).

Reading Higher Than 0.1 Volt
Shorted isolation diode.
Shorted key switch.

2. Turn key switch on (engine stopped) and note voltmeter reading. A high reading may be corrected by deflecting the alternator belt to turn the alternator shaft slightly.

Reading Above 2.5 Volts
Open circuit or high resistance in alternator field circuit.
Defective brushes.
Disconnected regulator.
Defective regulator.

Reading Below 1 Volt
Defective regulator.
Shorted field windings.
Open circuited alternator energizing circuit.

If voltage is not correct, make test under "Testing Alternator Field Circuit on Engine."

3. With all accessories off, run engine at approximately 1400 rpm.

Reading Below 15 Volts
Discharged battery.
Defective diodes.
Defective stator.
Move voltmeter lead from regulator terminal (Fig. 5) to output terminal.

Output Terminal Voltage in Excess of One Volt Below Regulator Terminal
Open circuited isolation diode.

Testing Alternator Field Circuit on Engine

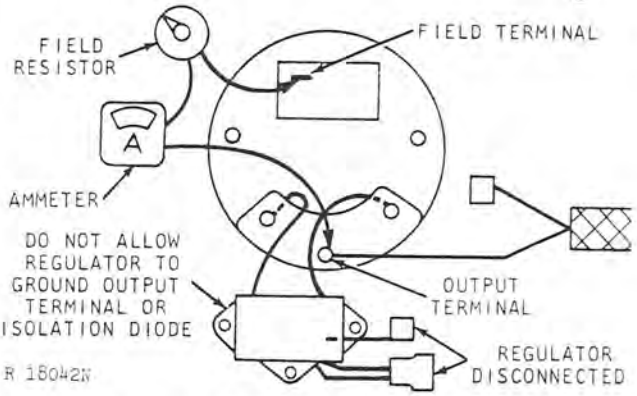


Fig. 6-Ammeter Connected to Field Terminal and to Alternator Output Terminal

With key switch off, detach regulator and disconnect regulator multiple connector and the green wire. Make test connections shown in Fig. 6. Do not ground green wire. Do not allow regulator body to touch both a grounded surface and the output terminal or isolation diode assembly. Resistor prevents damage if field has a short or a ground.

Reading Above 2.6 Amps
Short or ground in rotor windings.
Shorted brushes.

Reading Below 1.9 Amps
Dirty slip rings.
High resistance or open circuit in rotor windings.
Defective brushes.

DIAGNOSIS AND TESTS—Continued

Testing Motorola Alternators—Continued

Testing Alternator on Engine Using Voltmeter

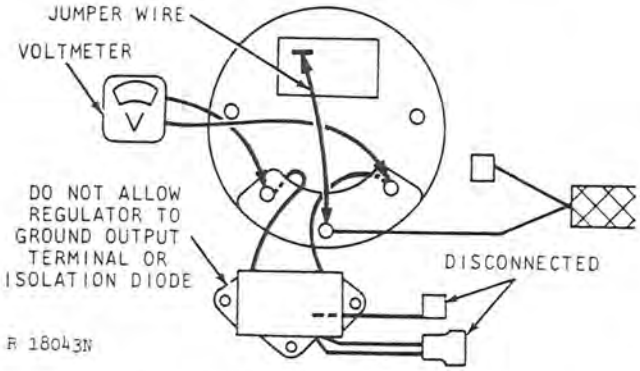


Fig. 7-Jumper Wire and Voltmeter Connections

With key switch off and regular disconnected, connect jumper wire and voltmeter (Fig. 7). Do not allow regulator to ground output terminal or isolation diode assembly. Run engine at approximately 800 rpm.

Reading Below 15 Volts

Batteries not fully charged. (Increase engine rpm. Do not exceed 16.5 volts).
Defective field circuit. (See previous test.)
Defective stator.
Defective diodes.

Testing Alternator with Regulator on Engine

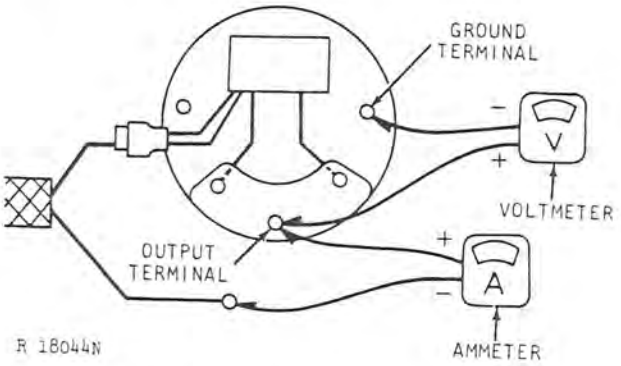


Fig. 8-Alternator with Regulator Test Connections

Disconnect wire from alternator output terminal and connect ammeter (Fig. 8). Battery ground should be disconnected while connecting ammeter. Connect voltmeter leads to output terminal and ground terminal. Connect a carbon pile resistor (turned off) to the battery. Run engine at 1443 rpm. Use a master tachometer for engine rpm. Adjust carbon pile to obtain maximum output. If using a tong-type ammeter or a battery post adapter on a naturally aspirated engine, subtract from specified output the 2-1/2 amps required by the engine shutoff mechanism.

Alternator	Output
35-amp	25 amps
55-amp	45 amps
72-amp	65 amps

Testing Regulator

The regulator must be checked with an alternator that is in good condition. If the alternator is questionable, check it as previously instructed.

Connect voltmeter with ±0.1-volt accuracy to the alternator output terminal and ground terminal (Fig. 8). With charged batteries and the regulator brought to operating temperature, the voltage should be as specified for the surrounding air temperature. If battery is partially discharged, it may be necessary to connect a 1/4-ohm resistor in series with the ammeter.

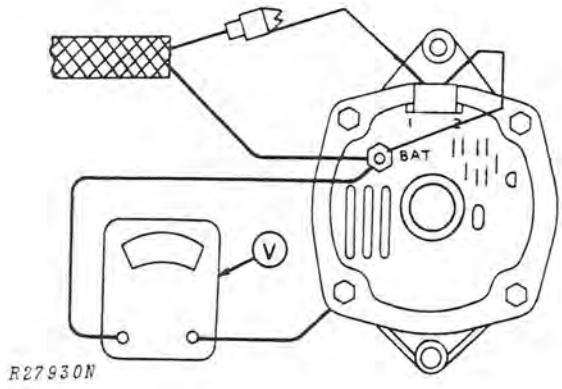
Temperature*	Voltage
40°F (4.4°C)	14.4 - 14.9 volts
60°F (15.6°C)	14.3 - 14.7 volts
80°F (26.7°C)	14.2 - 14.6 volts
100°F (37.8°C)	14.0 - 14.4 volts
120°F (48.9°C)	13.8 - 14.3 volts
140°F (60.0°C)	13.6 - 14.1 volts

** Measured 1 inch (25.4 mm) from regulator.*

Testing Delcotron Alternators

Testing Battery Connection

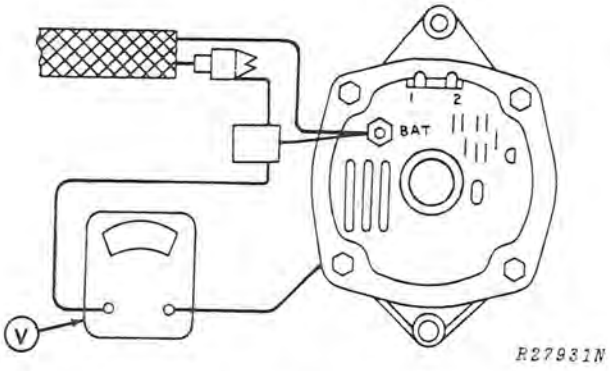
With engine stopped and key switch turned off, use D-19001TT volt-ohm-amp meter to check for battery voltage at alternator. .



V—Voltmeter

Fig. 9-Checking for Open Circuit to BAT Terminal

1. Connect voltmeter between BAT terminal on alternator and a good ground. It should indicate battery voltage. If it does not, check for an open circuit between BAT terminal and battery.



V—Voltmeter

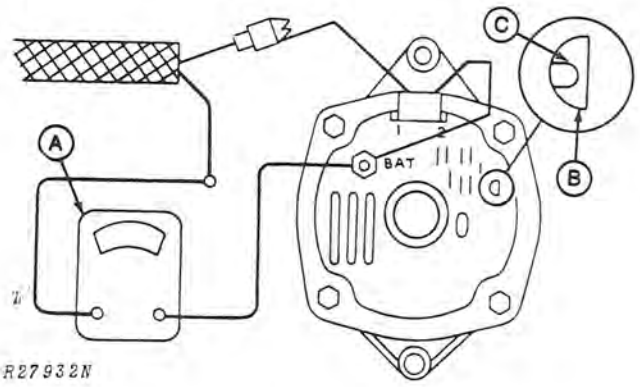
Fig. 10-Checking for Open Circuit To Terminals 1 and 2

2. Remove connector from terminals 1 and 2. Connect voltmeter between red wire in connector and a good ground. It should indicate battery voltage. If it does not, check for an open circuit between connector and starter circuit relay.

3. Turn key switch on. Connect voltmeter between orange wire in connector and a good ground. It should indicate battery voltage. If it does not, check for an open circuit between connector and ACC terminal of key switch.

Testing Output Voltage

To see whether alternator is charging, use volt-ohm-amp meter to compare voltage at BAT terminal with engine stopped and with it running.



A—Ammeter
B—Test Hole
C—Tab

Fig. 11-Checking Alternator Output

1. With COM terminal probe connected to alternator frame, connect V-2-A terminal probe to BAT terminal.

2. Read voltage, then start engine and run at 1500 rpm. Voltage should increase by at least 0.5 volts.

3. After engine has run several minutes to charge batteries, voltage should be as indicated in the following chart. If it is not, check field windings, See Group 10 of Section 40.

Air Temperature 1 in. (25 mm) Behind Regulator Case	Voltage
85°F (29°C)	13.8 - 14.9 volts
105°F (41°C)	13.6 - 14.7 volts
125°F (52°C)	13.4 - 14.6 volts
145°F (63°C)	13.2 - 14.4 volts

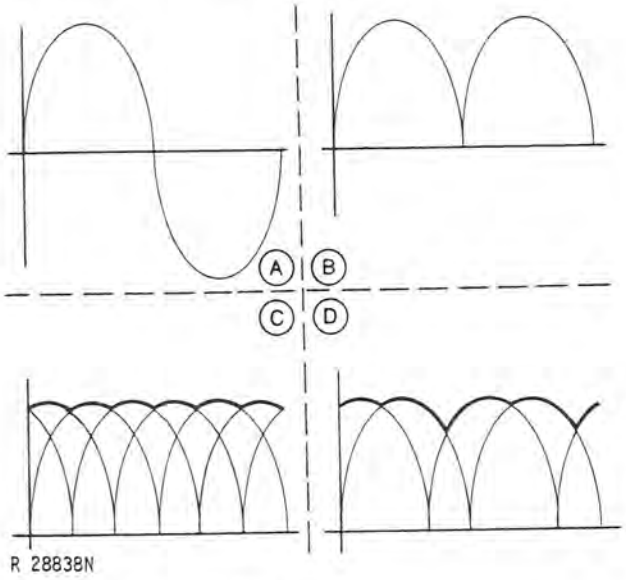
4. If voltage does not increase when engine is started, insert a small screwdriver in test hole and ground tab to alternator case.

If voltage did not increase when engine was started, but does increase when tab is grounded, regulator is defective and must be replaced. See Group 15 of Section 40.

Testing Output Voltage—Continued

With volt-ohm-amp meter connected to terminal 1 switch meter setting to check for an AC voltage ripple.

If ripple exceeds 0.4 volts, stator or rectifier bridge is defective. Replace or disassemble and repair alternator. See Group 15 of Section 40.



A—Voltage Output of One Phase
B—Voltage Output of One Phase After Passing Through Rectifier Bridge
C—Smooth Voltage Output from Three Phases
D—Voltage "Ripple" Caused by One Defective Phase

Fig. 12-Output Voltage Ripple

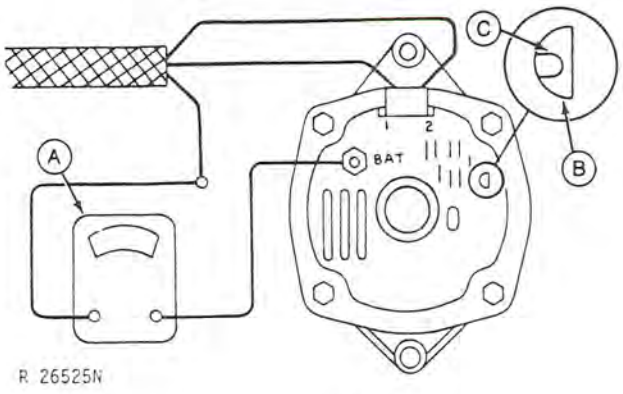
Amperage Output Test

NOTE: This test is not needed if the preceeding tests have been made. It is included for those shops which do not have equipment to measure AC voltage ripple.

1. Disconnect red wire from BAT terminal. Do not let wire contact alternator frame or any ground.

2. Connect ammeter between wire and terminal.

3. Turn on all electrical accessories to draw maximum load. If batteries are fully charged, disengage rack puller and crank engine 15 to 20 seconds.



A—Ammeter
B—Test Hole
C—Tab

Fig. 13-Testing Amperage Output

4. Run engine at 1900 rpm and observe output.

DELCOTRON ALTERNATOR OUTPUT SPECIFICATION

Alternator	Minimum Output
37-Amp	30 amps
55-Amp	45 amps
61-Amp	50 amps
72-Amp	60 amps

5. If output is low and you are certain that batteries are not fully charged, insert a small screwdriver in test hole and ground tab to alternator case.

If output increases, replace regulator. If output does not increase, check field windings, brushes, diode trio, rectifier bridge, and stator. See Group 15 of Section 40.

NOTE: See Section 40, Group 15 for removal, disassembly, and repair of alternator.

Group 15
STARTING CIRCUIT DIAGNOSIS

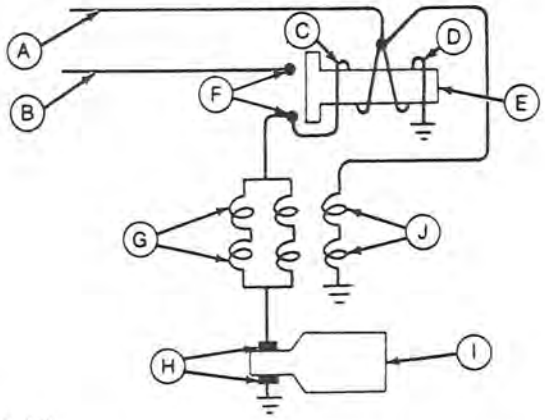
GENERAL INFORMATION

NOTE: See Section 40, Group 20 for Delco-Remy starting circuit repair. See Section 40, Group 25 for John Deere starting circuit repair.

IMPORTANT: Never operate starting motor longer than 30 seconds. Allow at least two minutes for cooling and battery recovery before operating again. Overheating, caused by excessive operation, will seriously damage starting motor.

Delco-Remy and John Deere starting motors are totally interchangeable without modification or additional parts.

HOW THE SYSTEM WORKS



RG1313

A—From Power Source
B—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

Fig. 1-Circuitry Inside Starter

When wire from power source (A, Fig. 1) 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, both ends of pull-in winding have the same voltage, so current through the pull-in winding stops. Current continues through the hold-in winding, keeping solenoid engaged and main contacts closed.

With main contacts closed, current flows from battery cable (B) to starting motor at a very high rate. Four heavy field windings (G) carry current to commutator brushes (H).

On John Deere starting motors, light shunt windings (J) are wrapped together with two of the field windings. Shunt windings are connected to the solenoid switch terminal and directly to ground. They prevent overspeeding of the motor, and assist in pinion engagement with the ring gear.

From the field windings, current flows through the armature windings (I) to ground, making contact through the 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, causing the armature to rotate.

When solenoid engages, it pulls shift lever (3, Fig. 2). Shift lever pushes clutch unit (19) to engage pinion with ring gear on flywheel. As the armature turns, it cranks the engine.

When the engine starts, the clutch unit spins freely on the shaft, preventing overspeeding of the armature.

When key switch is released, current to the solenoid hold-in winding is cut off. Current can feed through both windings from main contacts, but direction of current is reversed in the pull-in winding. The two windings cancel each other and the solenoid is released.

A spring pushes the solenoid back to its disengaged position, opening the main contacts and shutting off current to the field windings and the armature.

The shift lever retracts the clutch unit, pulling the pinion away from the flywheel. The brake washer (18) slows the armature to a stop.

OPERATION—Continued

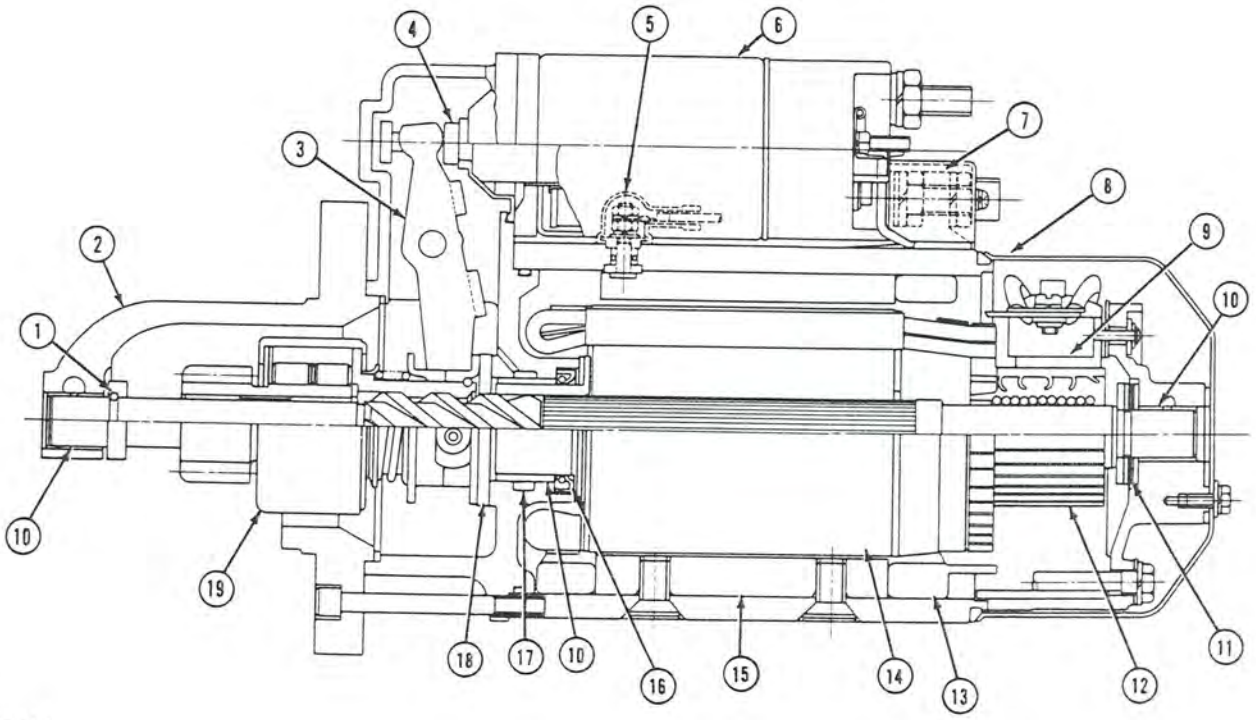


Fig. 2-John Deere Starting Motor

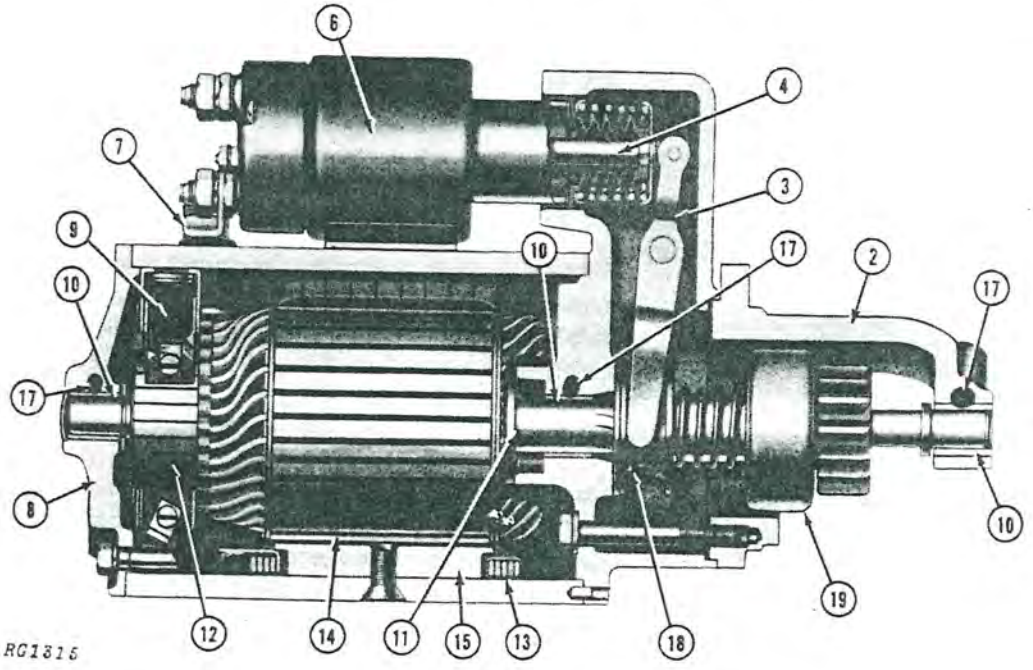


Fig. 3-Early Model Delco-Remy Starting Motor

Key for Figs. 2 and 3

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—Felt Oil Wick
18—Brake Washer
19—Clutch Unit

DIAGNOSIS AND TESTS

Remember two basic rules when working with starting motors.

1. Diagnose the problem as thoroughly as possible before beginning disassembly.

2. Disassemble only as far as necessary to correct problem.

Diagnosing Malfunctions

Any starting motor malfunction will almost certainly result in one of the following five situations.

A—When key switch is turned to start position, nothing happens. Solenoid does not click.

B—Solenoid clicks, but starting motor does not operate.

C—Starting motor runs, but does not crank engine.

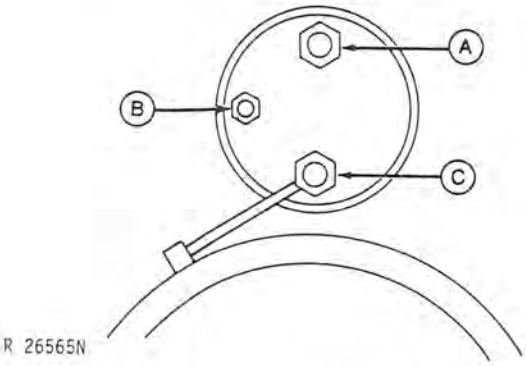
D—Starting motor cranks engine slowly or erratically.

E—Engine starts, but starting motor will not disengage.

Determine which of the five situations applies, and diagnose problem as instructed for those symptoms.

A—When key switch is turned to start position, nothing happens. Solenoid does not click.

Solenoid is not engaging. This usually means problem is in solenoid or wiring.



A—Battery Terminal
B—Switch Terminal
C—Motor Terminal

Fig. 4-Solenoid Terminals

1. Connect a jumper wire to positive terminal of battery. Briefly touch jumper wire to switch terminal (B, Fig. 4) of solenoid. If starter operates, problem is in wiring or switches.

2. If starter does nothing when jumper wire is touched to switch terminal, test batteries as instructed on page 1 of Group 05. Make sure all battery cable connections are clean and tight.

3. If batteries and connections are good, remove and test solenoid as instructed in Group 20 or 25 of Section 40.

B—Solenoid clicks, but starting motor does not operate.

1. Make sure all battery cable connections are clean and tight. Low voltage caused by a poor connection is a common problem.

2. Test batteries as instructed on page 1 of Group 05. Recharge or replace batteries if necessary.

3. If solenoid chatters and low voltage is not the cause, an open circuit in hold-in winding is indicated. Replace solenoid.

4. If solenoid appears to work properly, problem is inside starting motor. Remove and check starting motor as instructed in Group 20 or 25 of Section 40.

C—Starting motor runs, but does not crank engine.

Problem would appear to be a defective overrunning clutch drive, defective shift mechanism, or broken armature shaft.

Whatever the case, starting motor must be removed and checked as instructed in Group 20 or 25 of Section 40.

DIAGNOSIS AND TESTS—Continued

D—Starting motor cranks engine slowly or erratically.

1. Make sure all battery cable connections are clean and tight. Low voltage caused by a poor connection is a common problem.

2. Test batteries as instructed on page 1 of Group 05. Recharge or replace batteries if necessary.

3. If low voltage is not at fault, problem is inside starter. Brush assembly could be defective. Field windings or armature windings could be short circuited or open circuited. Bushings, pinion, or flywheel ring gear could be defective and binding. Pole shoes could be dragging on armature.

E—Engine starts, but starting motor will not disengage (John Deere Starter Only).

Solenoid, shift lever, and overrunning clutch drive are not returning to their disengaged positions. Shunt windings could be open circuited. Overrunning clutch drive could be binding on armature shaft. Solenoid or shift lever could be defective.

1. First see whether shunt winding is open circuited. When key switch is released, current can feed backward from main contacts through pull-in windings to switch terminal, it flows through shunt windings and hold-in windings to ground. Pull-in and hold-in windings cancel each other, and solenoid is released. If shunt windings are open circuited, too little current can flow through pull-in windings, and solenoid will not release.

Make sure shunt winding lead from solenoid is in good condition. See that connection is clean and tight. Use an ohmmeter or test lamp to test for continuity between shunt winding terminal and ground. If test does not show continuity, remove starting motor and repair or replace windings. See Group 20 or 25 of Section 40.

2. If shunt windings are not open circuited, remove solenoid. Manually move shift lever back and forth. If shift lever works smoothly, repair or replace solenoid. If shift lever binds, remove and check starting motor as instructed in Group 20 or 25 of Section 40.