Group 25
JOHN DEERE STARTING CIRCUIT REPAIR

GENERAL INFORMATION

NOTE: See Section 240, Group 15 for starting circuit diagnosis.

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.

SOLENOID

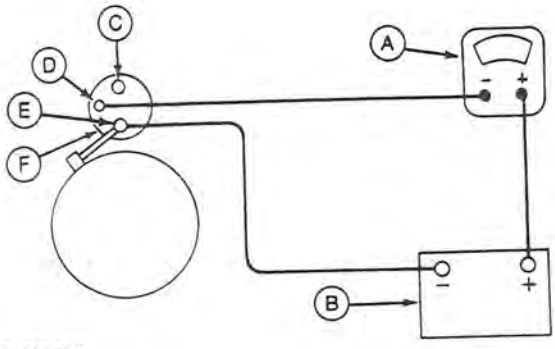
Solenoid can be removed and checked without removing starting motor.

1. Disconnect battery ground cable.

2. Disconnect cable and wires from solenoid terminals. Disconnect strap from field terminal.

3. Remove two cap screws securing solenoid to shift lever housing. Carefully remove solenoid.

4. Manually move shift lever back and forth. If mechanism appears to bind, solenoid may not be at fault. Remove and check starting motor as instructed on following pages.



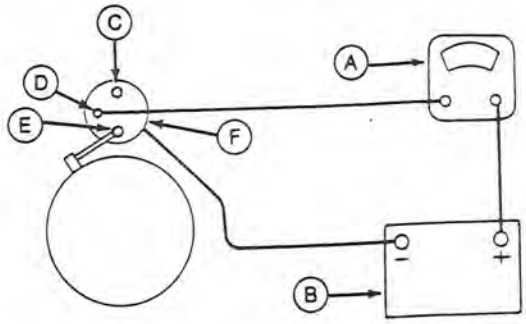
A—Ammeter
B—12-Volt Battery
C—Battery Terminal
D—Switch Terminal
E—Motor Terminal
F—Solenoid Frame

Fig. 1-Measuring Pull-In Winding Current Draw

IMPORTANT: Do not energize solenoid windings when plunger is unrestrained. Either reinstall solenoid on starting motor or restrain plunger to prevent movement.

5. Connect ammeter in series with pull-in winding as shown in Fig. 1. Use an ammeter capable of measuring several hundred amps. Current draw should be about 140 to 155 amps at 12 volts.

IMPORTANT: Do not energize pull-in windings longer than five seconds. Heat builds up rapidly and could damage windings.



A—Ammeter
B—12-Volt Battery
C—Battery Terminal
D—Switch Terminal
E—Motor Terminal
F—Solenoid Frame

Fig. 2-Measuring Hold-In Winding Current Draw

6. Connect ammeter in series with hold-in winding as shown in Fig. 2. Current draw should be approximately 11 to 13 amps at 12 volts.

7. If current draw for either winding is significantly higher or lower than specified, it indicates the following:

High Ammeter Reading

Windings short circuited or grounded

Low Ammeter Reading

Excessive resistance in circuit, usually due to poor connection

No Ammeter Reading

Windings open circuited

8. Remove end cap from solenoid. Check for poor connection or damaged wire. Unless problem can be found in this area, solenoid must be replaced.

STARTING MOTOR REMOVAL

Inspection and Removal

1. Inspect starting motor for obvious defects before removing it. Check for loose mounting bolts or pole shoe retaining screws. Operate starting motor and listen for rattling, squealing, or grinding.

2. Disconnect battery ground cable.

3. Disconnect cable and wires from solenoid.

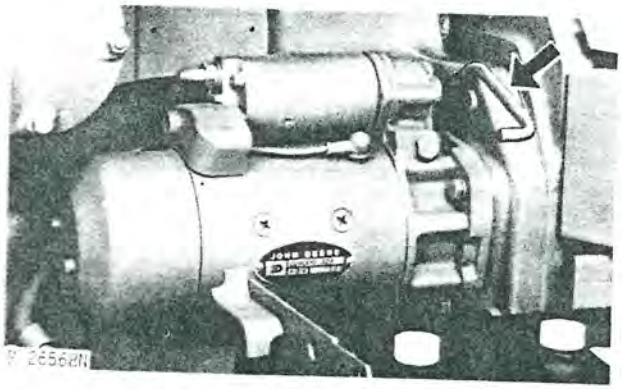


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Fig. 3-Using JDE-80 Starter Wrench

4. Remove mounting bolts. Use JDE-80 Starter Wrench to reach bolt behind starting motor.

Tests Before Disassembly

Observe starting motor carefully before beginning disassembly. Problem may be readily apparent, making repair much easier.

Checking for Interference

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Fig. 4-Turning Overrunning Clutch Drive by Hand

1. Turn overrunning clutch drive by hand. It should turn freely on shaft in overrunning direction only.

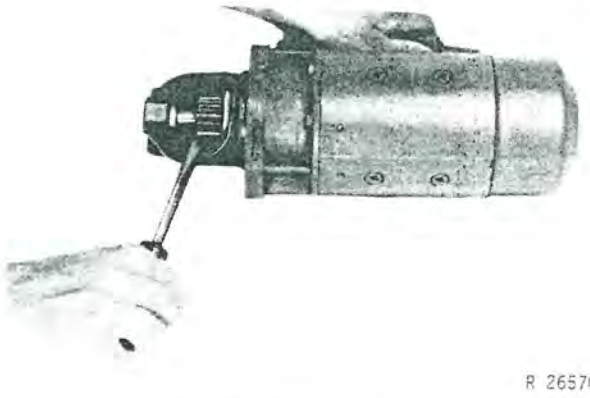

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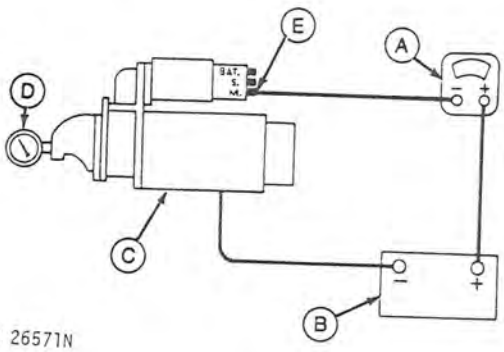
Fig. 5-Turning Armature by Hand

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 starting motor. See instructions on following pages. Do not conduct no-load test unless armature turns freely.

No-Load Test



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A—Ammeter
B—12-Volt Battery
C—Motor Frame
D—Tachometer
E—Motor Terminal

Fig. 6-No-Load Test

1. If armature turns freely in step 2, make connections shown in Fig. 6 and conduct no-load test. Use an ammeter capable of measuring several hundred amps.

Current draw should be approximately 90 to 130 amps at 12 volts. Armature speed should be approximately 4000 to 5000 rpm.

2. If speed and current draw are slightly low, connect a voltmeter between motor terminal and motor frame. Observe voltage during test. Voltage may be reduced because of high current draw on battery.

3. If speed or current draw is significantly different than specified, diagnose problem as follows.

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

DISASSEMBLY AND REPAIR

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.

Whenever starting motor is disassembled for any reason, lubricate it as follows.

1. Resaturate center bearing and oil wick with medium grade engine oil.

2. Apply a coat of Bosch VS 10 832 Ft grease* to both end bearings, grease reservoirs for both end bearings, armature shaft except center bearing area, brake washer, both ends of shift lever, and shift lever pivot shaft.

*If specified grease is not available, substitute Esso Beacon 325 or Delco-Remy Lubricant No. 1960954.

3. Avoid excessive lubrication.

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. Wipe overrunning clutch drive with a clean cloth.

NOTE: Starting motor has metric bolts and nuts except for those on switch cover.

Brush Assembly

A—Grounded Brushes
B—Insulated Brushes
C—Brush Spring

Fig. 7-Brush Assembly

1. Remove end frame cover.

2. Inspect brushes (A and B, Fig. 7) closely. Make sure brushes are not binding in holders. Full width of each brush should contact commutator.

3. Replace brushes if they are oil soaked or worn to less than 5/8 inch (16 mm) in length.

4. Check each brush spring (C) to be sure it is holding brush tight against commutator. Check brush spring tension using a spring scale. Tension should be a minimum of 40 oz. (11 N). Replace springs if they are distorted, discolored, or weak.

5. To remove brushes, remove brush lead screws. Pry brush spring out of way, and pull brush out of holder.

Brush Assembly—Continued

A—Brush
B—Brush Spring

Fig. 8-Brush Installation

6. When installing brushes, cross brush leads 180° as shown in Fig. 8. On insulated brushes, push leads down tight against brushes to prevent grounding.

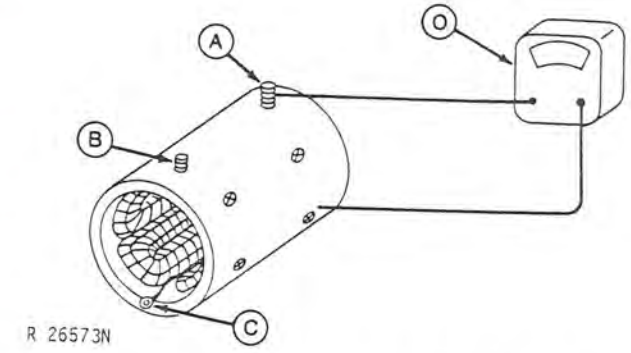
Field Windings

Removal

1. Remove terminal cover and field connector. Disconnect shunt winding lead.
2. Remove end frame cover.
3. Remove brush lead screws from two insulated brushes.
4. Remove two cap screws securing end frame to main frame. Remove end frame.
5. Chalk a reference mark across drive housing, shift lever housing, and main frame for proper reassembly.
6. Remove eight special screws securing drive housing and shift lever housing to main frame. Carefully remove main frame.

Testing

Use an ohmmeter or test lamp to test for continuity between field terminal and main frame as shown in Fig. 9. Be sure brush connectors are not touching frame.

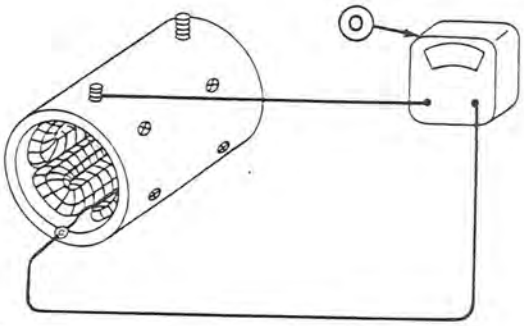


A—Field Terminal
B—Shunt Winding Terminal
C—Shunt Winding Ground
O—Ohmmeter

Fig. 9-Testing Field Windings for Grounds

Disconnect shunt winding ground inside main frame. Be sure that wire is not touching frame, and use an ohmmeter or test lamp to test for continuity between shunt winding terminal and frame.

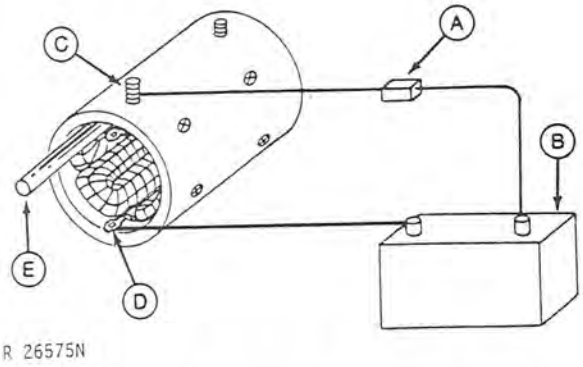
If either test shows continuity, windings are grounded. Check for worn insulation. Repair or replace windings.



O—Ohmmeter

Fig. 10-Testing Shunt Winding for Open Circuit

With shunt winding ground disconnected, use an ohmmeter or test lamp to test for continuity between shunt winding ground and shunt winding terminal as shown in Fig. 10. If test does not show continuity, shunt winding is open circuited. Repair or replace windings.

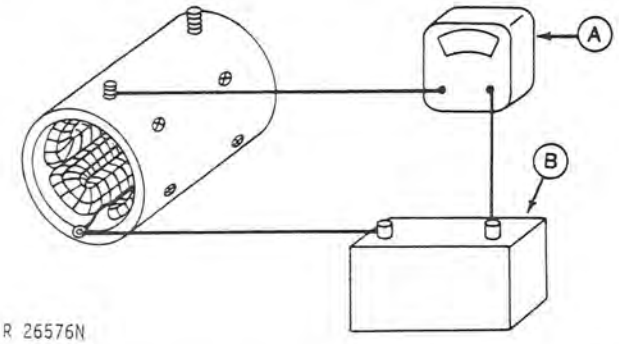


A—1/4-Ohm Resistor
B—12-Volt Battery
C—Field Terminal
D—Insulated Brush Lead
E—Steel Bar

Fig. 11-Testing Field Windings for Open Circuits

Connect a test battery to field terminal and either insulated brush connector, using a resistor to limit current as shown in Fig. 11.

Use a steel bar to test each winding for magnetism. If windings do not have magnetism, they are open circuited. Repair or replace windings.



A—Ammeter
B—12-Volt Battery

Fig. 12-Testing Shunt Windings for Short Circuit

Connect an ammeter in series with shunt windings as shown in Fig. 12. Windings should draw 15 to 20 amps at 12 volts. A high reading indicates a short circuit. A low reading indicates a poor connection. Repair or replace windings if defective.

There is no suitable way to check field windings for short circuits. Winding resistance is too low to permit detection of a short circuit. If starting motor appears weak and no other cause can be found, replace field windings.

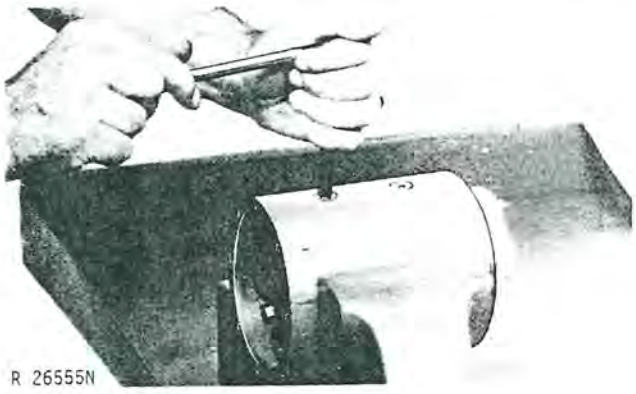


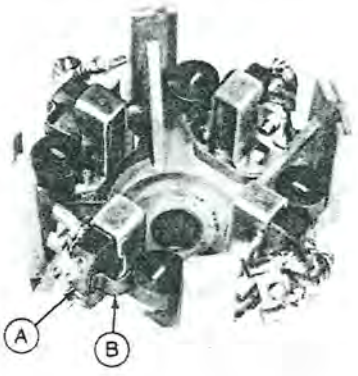
Fig. 13-Removing Pole Shoe Screws

If necessary to remove field windings, use a large screwdriver bit and socket wrench on pole shoe screws.

Take care to prevent distortion of main frame. Do not squeeze sides in vise or strike with hammer. If you must use an impact screwdriver to loosen screws, support each pole shoe individually, using a pole shoe spreader or the nose of an anvil.

Handle windings very carefully. They are easily damaged, causing shorts, opens, or grounds.

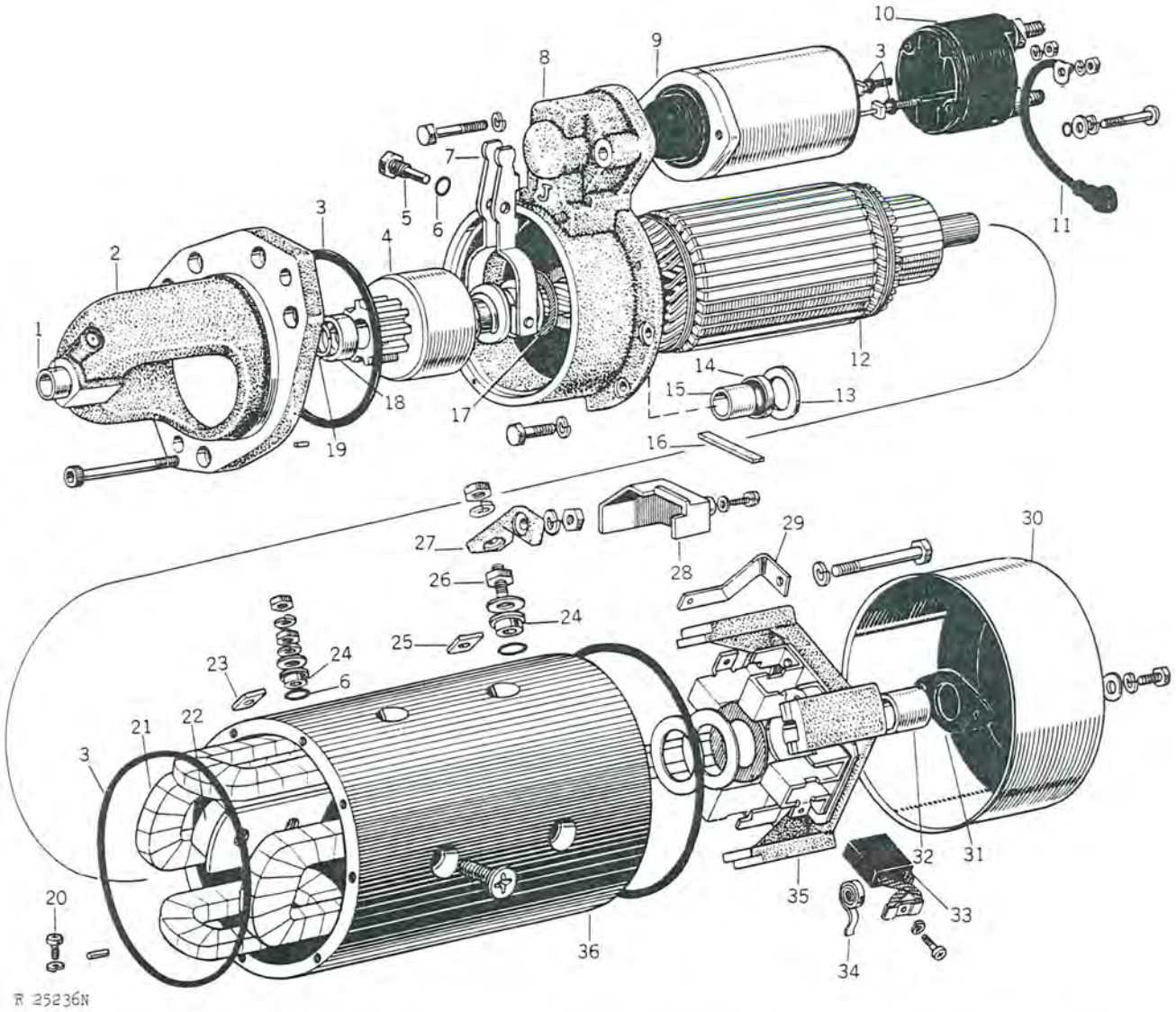
When installing field windings, tighten pole shoe screws as tight as reasonably possible. Use a center punch to lightly stake one edge of each screw.



A—Brush
B—Brush Spring

Fig. 14-Holding Brushes Back

Reassemble starting motor in reverse order of disassembly. Before installing end frame, push each brush back far enough for brush spring to rest against side of brush as shown in Fig. 14. After installing end frame, let brushes down against commutator.



1—Drive End Bushing
2—Drive End Housing
3—Packing
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
36—Field Frame

Fig. 15-Starting Motor

Overrunning Clutch Drive

Check overrunning clutch drive by hand before disassembling starting motor. Drive should turn smoothly in overrunning direction only. Drive should slide smoothly on armature shaft.

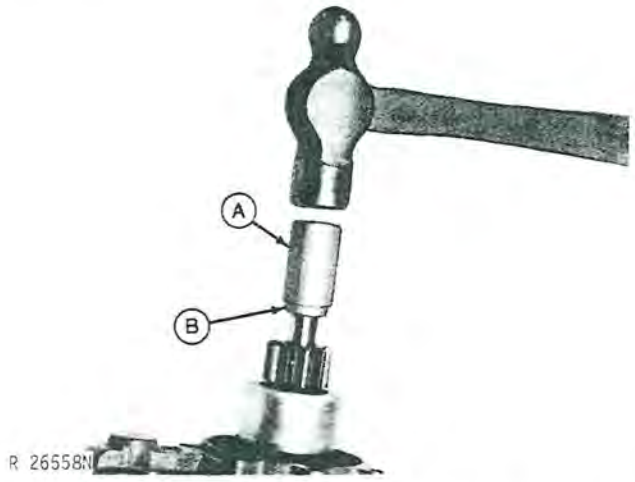
Removal

If necessary to remove overrunning clutch drive, use the following procedure.

1. Remove terminal cover and field connector from solenoid. Disconnect shunt winding lead, and remove solenoid.

2. Chalk a reference mark across drive housing, shift lever housing, and main frame for proper reassembly.

3. Remove eight special screws securing drive housing and shift lever housing to main frame. Remove drive housing.



A—Pipe Coupling **B—Pinion Stop**

Fig. 16-Removing Pinion Stop

4. Remove pinion stop. Use a pipe coupling or other metal cylinder to drive pinion stop toward pinion. Remove retaining ring and slide pinion stop off shaft.

5. Carefully slide shift lever housing and overrunning clutch drive off shaft. Do not slide armature out of brush assembly at other end of shaft.

Inspection

Inspect overrunning clutch drive for signs of overheating, caused by keeping switch engaged too long after engine starts.

If drive has been damaged, check armature shaft closely. Replace armature if you find any damage to shaft.

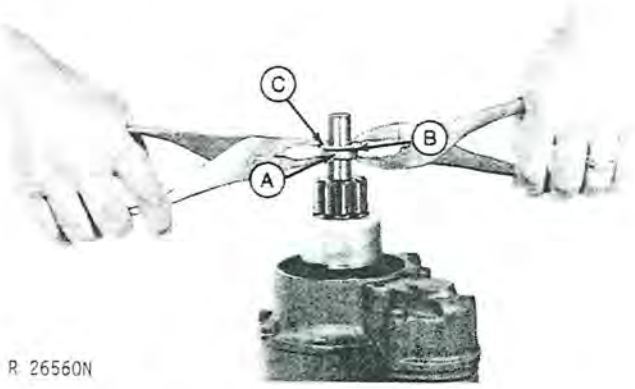
Overrunning clutch drive is not serviceable. Install new drive if old one is defective.

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.

Reassembly

1. Place overrunning clutch drive in shift lever housing, making certain that shift lever is engaged in slot.

2. Slide shift lever housing and overrunning clutch drive onto armature shaft.



A—Pinion Stop
B—Retaining Ring
C—Washer (Remove After Using)

Fig. 17-Installing Pinion Stop

3. Slide pinion stop onto shaft, with open side toward end of shaft. Install retaining ring in groove. Force pinion stop over ring, using a washer and two pairs of pliers as shown in Fig. 17. Remove washer.

4. Install shift lever housing and drive housing.

Armature

To remove armature, starting motor must be almost completely disassembled.

1. Remove terminal cover and field connector from solenoid. Disconnect shunt winding lead, and remove solenoid.

2. Remove end frame cover.

3. Remove brush lead screws from two insulated brushes.

4. Remove two cap screws securing end frame to main frame. Remove end frame.

5. Chalk a reference mark across drive housing, shift lever housing, and main frame for proper reassembly.

6. Remove eight special screws securing drive housing and shift lever housing to main frame. Remove drive housing.

7. Remove pinion stop. Use a pipe coupling or other metal cylinder to drive pinion stop toward pinion, as shown in Fig. 16. Remove retaining ring and slide pinion stop off shaft.

8. Remove main frame.

9. Carefully slide armature shaft out of shift lever housing and overrunning clutch drive.

IMPORTANT: Do not clean armature with solvent. Solvent could damage insulation on windings. Use only mineral spirits and a brush.

Give armature a close visual inspection. Look for signs of dragging against pole shoes. Look for scoring under bushings or overrunning clutch drive.

Carefully check commutator. Look for roughness, burned commutator bars, or any material which might cause short circuits between bars.

Clean and touch up commutator if necessary with 00 sandpaper. Never use emery cloth. Clean all dust from armature when finished.

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.

Undercut insulation between commutator bars to 1/32 inch (0.8 mm). Touch up commutator with sandpaper after using lathe. Clean dust and metal chips from armature when finished.

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Fig. 18-Checking Armature for Bent Shaft

Place armature in V-blocks and check for a bent shaft as shown in Fig. 18. Replace armature if shaft is bent.

If no-load test indicates possibility of grounded, short circuited, or open circuited windings, check armature for these defects. Windings are large, and defect might be easy to spot.

Grounded Windings

Symptoms — Starting motor cranks engine slowly or not at all. On no-load test, motor has low armature speed and high current draw or fails to operate and has high current draw.

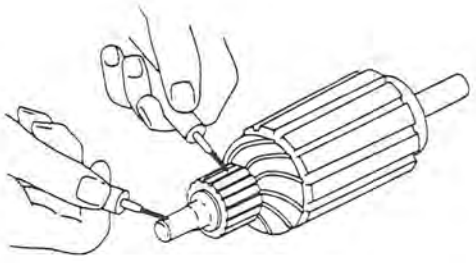

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Fig. 19-Checking Armature for Grounded Windings

Use an ohmmeter or test lamp to test for continuity between commutator bars and armature shaft. If test shows continuity, a winding is grounded. If fault cannot be corrected, replace armature.

All armature windings are connected in series, so you need to check only one commutator bar.

Short Circuited Windings

Symptoms — Starting motor cranks engine slowly. On no-load test, motor has low armature speed and high current draw.

Check armature carefully for windings which are bent and touching. Check commutator for anything which could conduct electricity between bars.

If a growler is available, use it to locate short circuit. Follow manufacturer's instructions.

Open Circuited Windings

Symptoms — Starting motor cranks engine slowly. On no-load test, motor has low armature speed and high current draw.

Open circuits are usually due to overheating caused by excessive cranking. Check connections of windings to commutator bars. Also look for burned edges on commutator bars.

Certain growlers are capable of locating open circuits. If one is available, use it according to manufacturer's instructions.

Open circuited windings can sometimes be repaired. Use solder and rosin flux.

Bushings

When installing new bushings, press bushings in from chamfered end of bores. Align holes in end bushings with lubrication wicks.

Install a new seal and lubrication wick when replacing center bearing. Saturate wick with medium grade engine oil.

Only if necessary, ream bushings after installation. I.D. of end bushings should be 0.669 to 0.670 inch (17.00 to 17.03 mm). I.D. of center bushing should be 1.182 to 1.184 inches (30.02 to 30.07 mm).

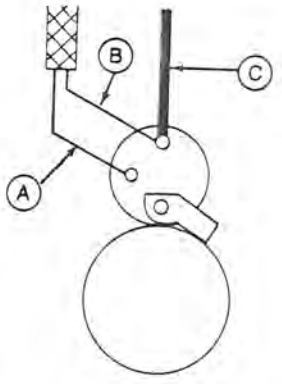
ASSEMBLY

Assemble starting motor in reverse order of disassembly. Install pinion stop as shown in Fig. 17. Use new seal and packings.

Apply a coat of Bosch VS 10 832 Ft grease to both end bearings, grease reservoirs for both end bearings, armature shaft except center bearing area, brake washer, both ends of shift lever, and shift lever pivot shaft. Avoid excessive lubrication.

**If specified grease is not available, substitute Esso Beacon 325 or Delco-Remy Lubricant No. 1960954.*

INSTALLATION



A—White **B—Red** **C—Positive Starter Cable**

Fig. 20-Starter Connections

Install starter. Use JDE-80 starter wrench on nut behind starter. Connect wiring harness and positive battery cable as shown in Fig. 20.

Section 50
POWER TRAIN REPAIR

CONTENTS OF THIS SECTION

Group 00
SPECIFICATIONS

SPECIFICATIONS

Item	Specification
Clutch disk thickness	
4270D; 6404D (Segmented disk)	0.432-0.442 in. (10.97-11.22 mm)
6404T, A; 6466	0.429-0.453 in. (10.90-11.51 mm)
Pilot bearing	
I.D.	1.1808-1.1811 in. (29.992-30.000 mm)
O.D.	2.8342-2.8346 in. (71.989-72.000 mm)
Clutch drive shaft	
4270D; 6404; 6466D, T; 6466A (-041994)	
O.D. at pilot bearing	1.1808-1.1811 in. (29.992-30.002 mm)
O.D. at bearing surface	
Side-load application	2.2515-2.2525 in. (57.188-57.214 mm)
In-line application	2.2330-2.2450 in. (56.718-57.023 mm)
O.D. at release collar sliding surface	2.2480-2.2490 in. (57.099-57.125 mm)
6466A (041995-)	
O.D. at pilot bearing	1.1808-1.1811 in. (29.992-30.002 mm)
O.D. at bearing surface	
Side-load application	2.6265-2.6275 in. (66.713-66.739 mm)
In-line application	2.5960-2.6080 in. (65.938-66.243 mm)
O.D. at release collar sliding surface	2.4490-2.5000 in. (62.205-63.500 mm)
Clutch separator springs	
4270D; 6404; 6466D, T; 6466A (-041994)	
Free length	1.06 in. (26.9 mm)
Compressive load	0.81 in. (20.06 mm) at 15-20 lbs. (67-89 N)
6466A (041995-)	
Free length	2.00 in. (50.8 mm)
Compressive load	1.18 in. (30.16 mm) at 15-20 lbs. (67-89 N)

SPECIFICATIONS—Continued

Item	Specification
Drive shaft end play	0.004-0.006 in. (0.10-0.15 mm)
Flywheel housing face run-out	0.008 in. (0.20 mm) Maximum variation
Flywheel face flatness	
Maximum variation	
4270D	0.006 in. (0.152 mm)
All other	0.009 in. (0.230 mm)
Maximum variation per 1.0 in. (25 mm) of area	0.0005 in. (0.013 mm)
Pilot bearing bore concentricity	0.005 in. (0.127 mm) Maximum variation
Torques	
Driving ring-to-flywheel	35 ft-lbs (47 Nm) (4.7 kgm)
Clutch housing-to-flywheel housing	
Side-load application 35 ft-lbs	35 ft-lbs (47 Nm) (4.7 kgm)
In-line application	55 ft-lbs (75 Nm) (7.5 kgm)
Drive shaft nut	170-180 ft-lbs (19.2-20.3 Nm) (1.95-2.07 kgm)
Operating lever engagement force	
4270D; 6404; 6466D, T; 6466A (-041994)	60-70 lbs. (267-311 N)
6466A (041995-)	65-75 lbs. (289-333 N)