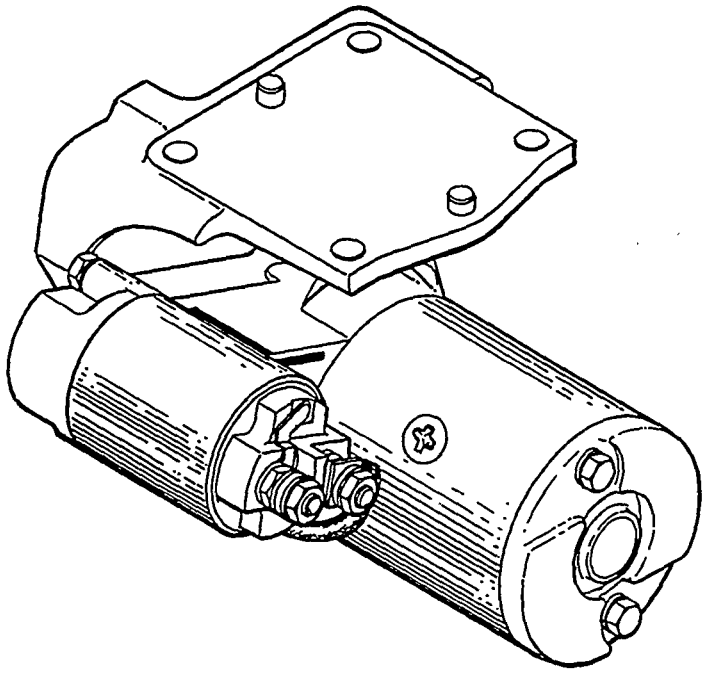
Textron Lycoming

Light Weight Starter

COMPONENT MAINTENANCE MANUAL



SSP-490
Engineering Aspects are FAA Approved

JANUARY, 1991

TEXTRON Lycoming

Williamsport Plant
Textron Lycoming/Subsidiary of Textron Inc.

652 Oliver Street
Williamsport, PA 17701 U.S.A.

SSP-490

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Light Weight Starter

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INTRODUCTION

This Special Service Publication (SSP) is to be used in conjunction with latest edition of Service Instruction No. 1447 (Light Weight Starter Installation Instructions).

The purpose of this publication is to depict the disassembly/assembly, inspection, testing, trouble shooting and spare parts listing of Textron Lycoming's Light Weight Starters.

CAUTION

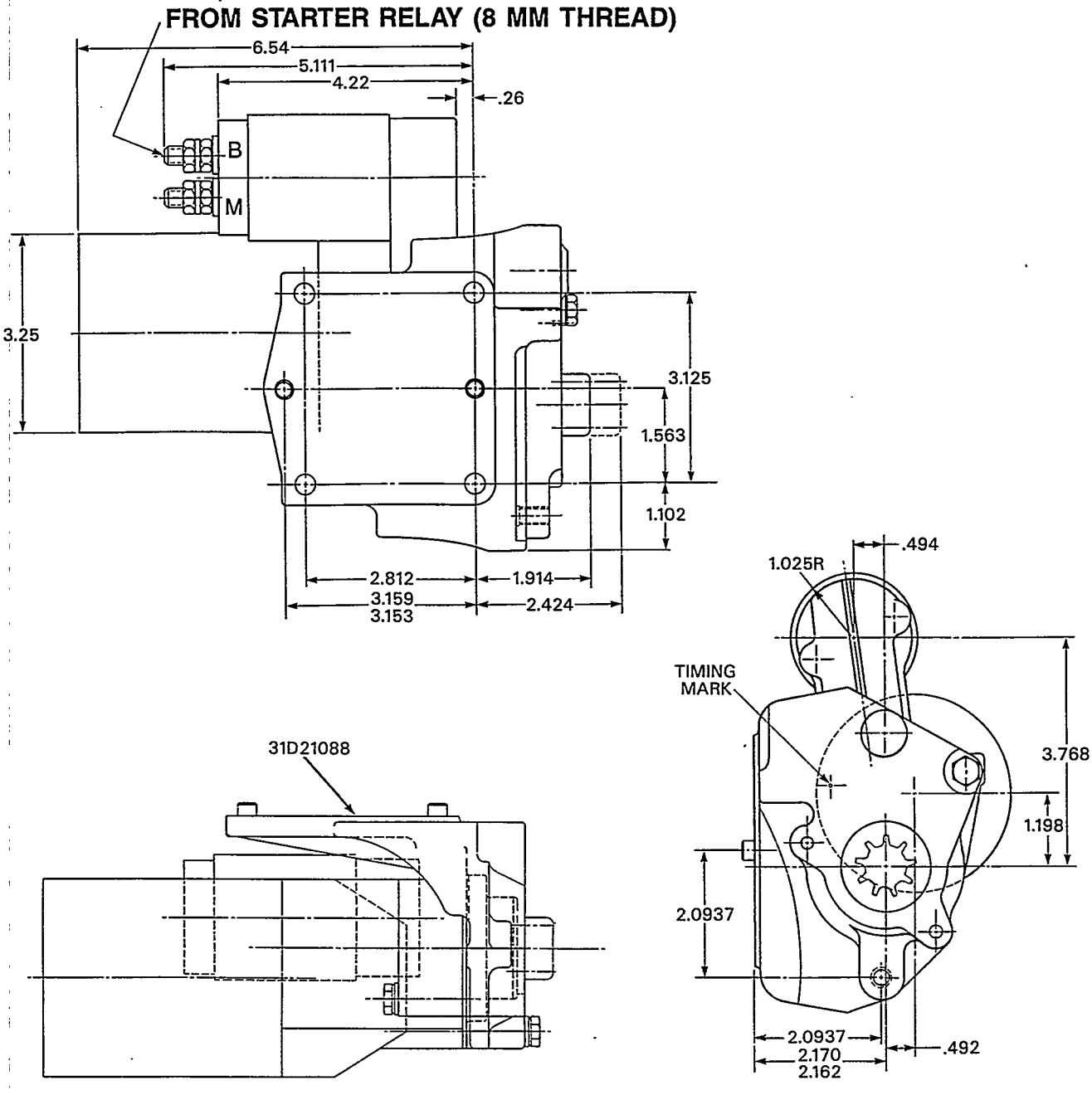
ALL FASTENERS AND THREADS ARE METRIC EXCEPT STARTER SUPPORT HOUSING P/N 31D21088 TO STARTER MOTOR ASSEMBLY BOLTS AND MOTOR CASE BOLTS WHICH ARE SAE 1/4-20 THREAD.

NOTE

Ascertain that the appropriate weight difference of this installation has been recorded. (Ref. Figure 7 Weight Chart in latest edition of Service Instruction No. 1447.) Some installations may require some trimming of Airframe Baffles. If this is required, an FAA Form 337 should be completed and made a permanent record of the Airframe.

TABLE OF CONTENTS

LIGHT WEIGHT STARTER DIMENSIONS
10/12 AND 12/14 PITCH



INSTALLATION INSTRUCTIONS

FOR STARTER INSTALLATION ON ENGINE REFER TO LATEST EDITION OF SERVICE INSTRUCTION NO. 1447.

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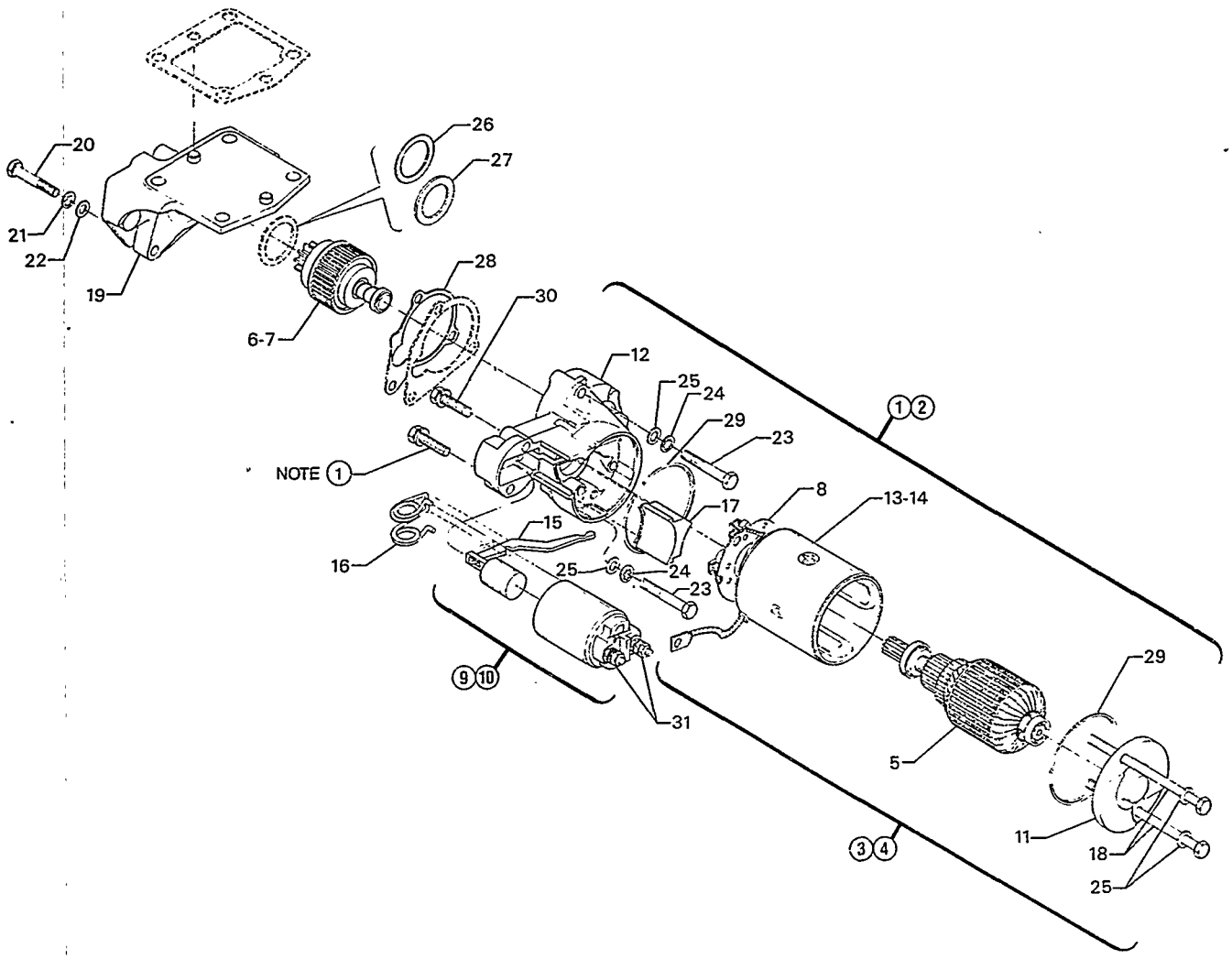

NOTE (1):

Solenoid Bolts Are Provided With Magnetic Switch Solenoid Assemblies.

Figure 1. STARTER MOTOR (Exploded View)

B-2932

SPARE PARTS DATA:

ITEM NO.	TEXTRON LYCOMING PART NO.	DESCRIPTION	QTY.
1	31R21384	12V. Starter Sub. Assy. (Complete Starter less Support Assy. & Pinion Drive Assy.)	1
2	31R21385	24V. Starter Sub. Assy. (Complete Starter less Support Assy. & Pinion Drive Assy.)	1
3	31R21386	12V. Starter Motor Sub. Assy. (Includes Armature Assy., Field Coil, Brush Plate Assy.	
		& End Cap)	1
4	31R21387	24V. Starter Motor Sub. Assy. (Includes Armature Assy., Field Coil, Brush Plate Assy.	
		& End Cap)	1
5	31R21388	Armature Assy. w / bearings	1
6	31R21389	Drive Assy. w / 12/14 pinion	1
7	31R21390	Drive Assy. w / 10/12 pinion	1
8	31R21391	Brush Plate Assy.	1
9	31R21392	Magnetic Switch Solenoid Assy. (12V.) (Includes Item No. 30 Bolts)	1
10	31R21393	Magnetic Switch Solenoid Assy. (24V.) (Includes Item No. 30 Bolts)	1
11	31R21394	End Cap	1
12	31R21395	Housing, Center	1
13	31R21396	Field Coil Housing Assy. (12V.)	1
14	31R21397	Field Coil Housing Assy. (24V.)	1
15	31R21398	Shift Lever	1
16	31R21399	Torsion Spring	1
17	31R21400	Dust Cover	1
18	31R21401	Case Bolts, 1/4-20 x 5 long	2
19	31D21088	Support Housing Assy.	1
20	LW-25-1.75	Bolt, 1/4-20 x 1-3/4 long, hex. head	1
21	STD-160	Washer, 1/4 lock, internal teeth	1
22	STD-8	Washer, 1/4 plain	1
23	LW-25-2.00	Bolt, 1/4-20 x 2.00 long, hex. head	2
24	STD-160	Washer, 1/4 lock, internal teeth	2
25	STD-8	Washer, 1/4 plain	4
26	01L21402*	Shim, Washer (0.5 mm)	AR
27	01L21403*	Shim, Washer (0.8 mm)	AR
28	06B21426	Gasket, Gear housing (see NOTE)	1
29	06C21427	"O" Ring	2
30	01C21424	Bolt, Solenoid, self-locking	2
31	01B21434	Nut, Solenoid terminal	2

* Reference Figure 13, Pages 7 and 8.

NOTE

One (1) only of P/N 06B21426 Gear Housing Gasket is required even though Shim Kit P/N 05K21194 has been installed. (Reference latest edition of Service Instruction No. 1447.) This is necessary to maintain proper spacing.

NOTE

Before Disassembly/Assembly of Starter, Read CAUTION on Introduction Page.

Removal of Starter Assembly From Engine.

1. Disconnect battery cable from magnetic switch solenoid on starter assembly.

2. Remove Starter Assembly from crankcase starter pad.

3. After removal of Starter Assembly, inspect Starter/Crankcase Shim P/N LW-16152 if one has been installed. If damaged or deteriorated, replace. Reference latest edition of Service Instruction No. 1447.

Disassembly Procedure For Reduction Gear Type Starter.

1. Remove Center Housing (Fig. 1, Item No. 12) from Support Housing (Fig. 1, Item No. 19) by removing the following:

   One (1) each 1/4-20 x 1-3/4 long bolt, flat washer and lock washer (Fig. 1, Item No. 20, 21 and 22).

   Two (2) each 1/4-20 x 2 long bolts, flat washers and lock washers (Fig. 1, Item No. 23, 24 and 25).

2. Removal of Solenoid From Starter Assembly.

   a. Prior to disassembly of Solenoid Assy. (Fig. 1, Item No. 9 and 10) identify connections, B-Battery and M-Motor.

   b. Disconnect wire from solenoid to motor.

   c. Remove (2) each solenoid bolts and lock washers (Fig. 1, Item No. 30 and 31) attaching Solenoid (Fig. 1, Item No. 9 and 10) to Center Housing (Fig. 1, Item No. 12).

   d. Remove Torsion Spring (Fig. 1, Item No. 16).

   e. Remove solenoid actuator core.

3. Remove (2) each 1/4-20 x 5 Case Bolts and 1/4 Flat Washers (Fig. 1, Item No. 18) and End Cap (Fig. 1, Item No. 11).

4. Remove Field Coil Housing Assy. (Yoke) (Fig. 1, Item No. 13 and 14), Armature Assy. (Fig. 1, Item No. 5) and Brush Plate Assy. (Fig. 1, Item No. 8) together as an assembly from Center Housing (Fig. 1, Item No. 12). Set aside.

CAUTION

TAKE PARTICULAR CARE NOT TO KNOCK BRUSHES, COMMUTATOR OR COIL AGAINST ANY ADJACENT PART.

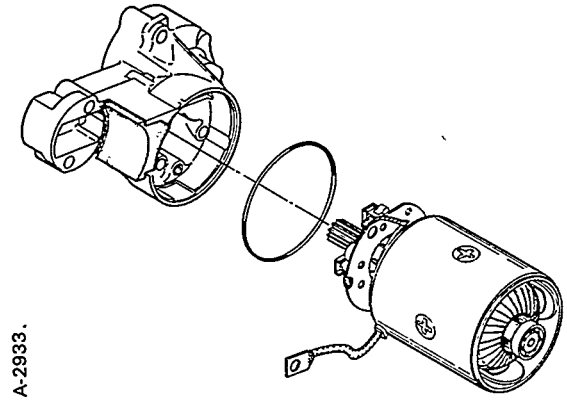

Figure 2. FIELD COIL HOUSING/CENTER HOUSING ASSY.

5. Remove Pinion Drive Assy. (Fig. 1, Item No. 6 and 7). On some starters, the Pinion Drive Assy. may require tapping with a 3/16'' brass drift pin. Never use steel or other hard metal which could cause damage to parts.

6. Remove Dust Cover (Fig. 1, Item No. 17).

7. Remove Shift Lever (Fig. 1, Item No. 15).

8. Pick up Field Coil Housing Assy. (Yoke) (Fig. 1, Item No. 13 and 14) and carefully lift brush springs with a screw driver or similar tool and slide brushes halfway out of holders on Brush Plate Assy. (Fig. 1, Item No. 8) and allow Springs to rest against brushes to allow removal of Armature Assy. (Fig. 1, Item No. 5).

9. Remove both positive (+) brushes from holders and lift off Brush Plate Assy. (Fig. 1, Item No. 8).

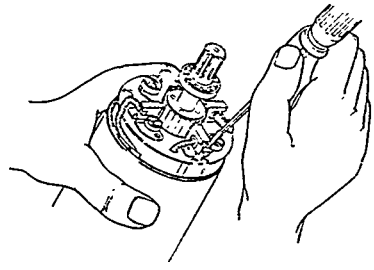

Figure 3. BRUSH REMOVAL

10. Remove Armature Assy. (Fig. 1, Item No. 5) from Field Coil Housing Assy. (Fig. 1, Item No. 13 and 14) taking care not to damage working surfaces or coated coils.

11. Proceed with inspection and testing.

INSPECTION OF COMPONENTS

A. Field Coil

1. Continuity test (between field coil positive terminal and positive brushes).

   • If no continuity extsts . . . Replace field coil.

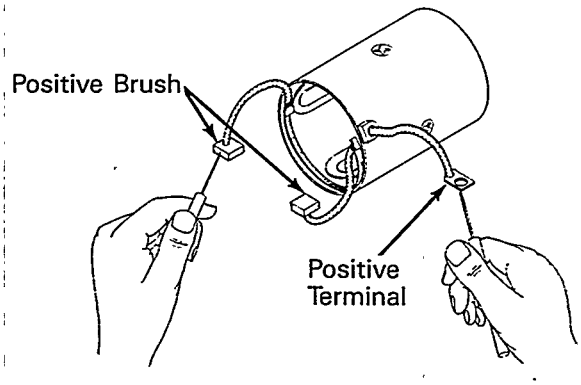

Figure 4. CONTINUITY TEST

2. Test for continuity between field coil positive terminal and yoke.

   • If continuity exists . . . Replace field coil.

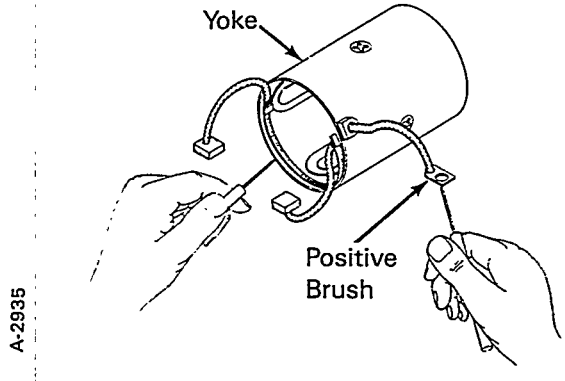

Figure 5. FIELD COIL TEST

B. Brushes

1. Check the surface condition of brush contact.

   • If contact is loose . . . Replace Brush Plate Assy. (Fig. 1, Item No. 8).

2. Check wear of brushes.

   • If excessive wear . . . Replace Brush Plate Assy. (Fig. 1, Item No. 8).

   Minimum length of brushes:

   11mm (0.43 in.)

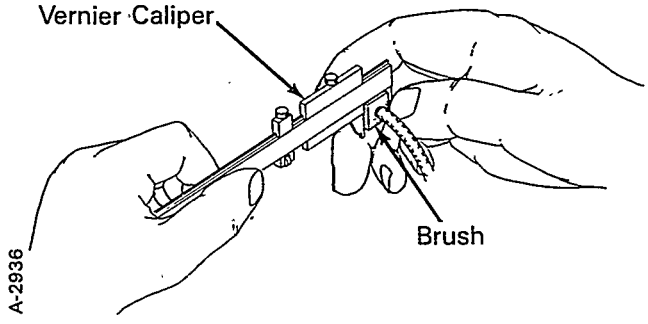

Figure 6. BRUSH WEAR CHECK

C. Brush Springs

1. Check brush spring tension.

   Spring tension: Reduction gear type.

   15.7 - 19.6 N
   1.6 - 2.0 Kg.
   3.5 - 4.4 Lb.

   • If not within the specified value . . . Replace Brush Plate Assy. (Fig. 1, Item No. 8).

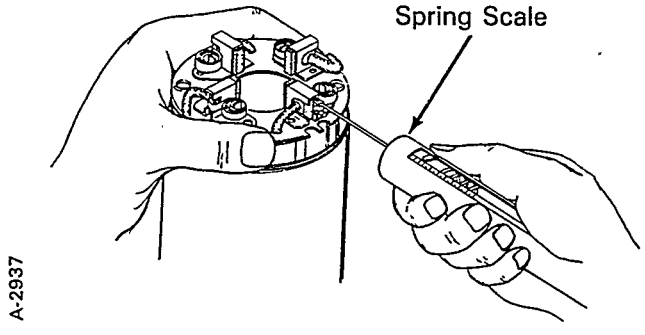

Figure 7. BRUSH SPRING TENSION

D. Armature Assembly

1. Check commutator surface.

   • If rough . . . Sand lightly with No. 400 sandpaper.

2. Check depth of insulating mica from commutator surface.
   - If less than 0.2mm (0.008 in.) . . . undercut to 0.5 - 0.8mm (0.020 - 0.031 in.).

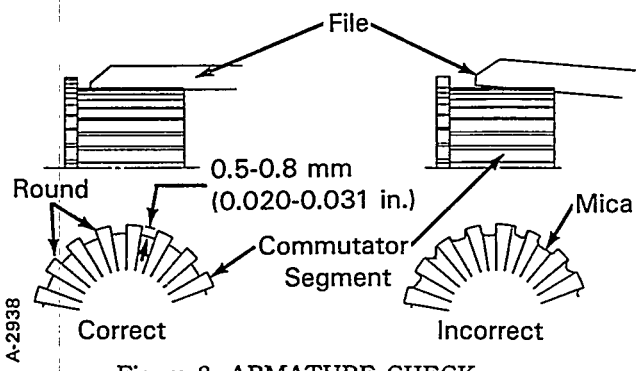

Figure 8. ARMATURE CHECK

3. Check diameter of commutator. Commutator minimum diameter:

   29mm (1.14 in.)
   - If less than specified value . . . Replace Armature Assy. (Fig. 1, Item No. 5).

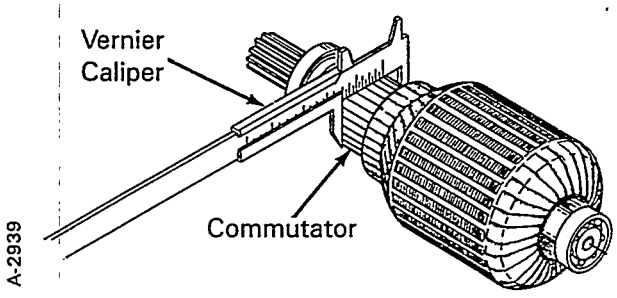

Figure 9. COMMUTATOR CHECK

4. Test for continuity between each commutator segment and shaft.
   - If continuity exists . . . Replace Armature Assy. (Fig. 1, Item No. 5).

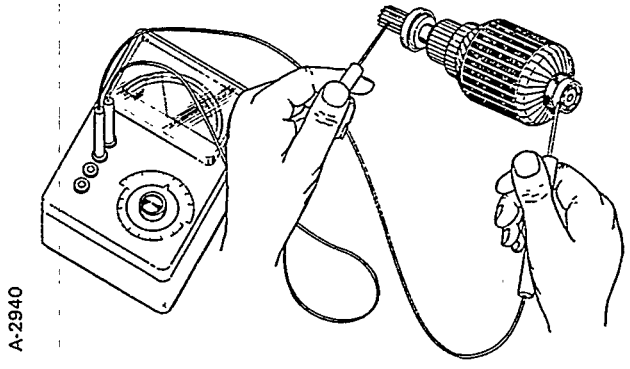

Figure 10. ARMATURE GROUND TEST

5. Short test with armature tester (growler) and a piece of iron over armature core.
   - If iron piece vibrates . . . Replace Armature Assy. (Fig. 1, Item No. 5).

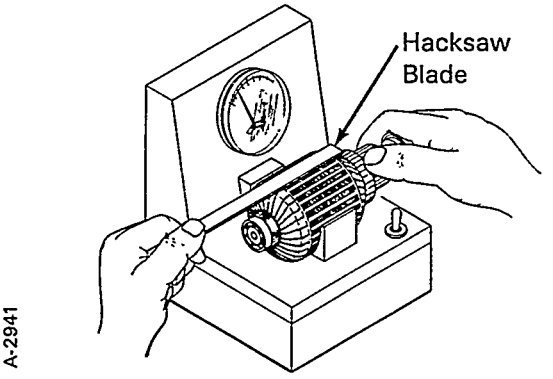

Figure 11. ARMATURE SHORT TEST

6. Test for continuity between two segments side by side.
   - If no continuity exists . . . Replace Armature Assy. (Fig. 1, Item No. 5).

E. Pinion Drive Assembly

1. Inspect for smooth sliding of pinion gear.
   - If abnormal resistance . . . Replace Pinion Drive Assy. (Fig. 1, Item No. 6 & 7).
2. Inspect pinion teeth.
   - If excessive rubbing . . . Replace Pinion Drive Assy. (Fig. 1, Item No. 6 & 7).

CAUTION

STARTER RING GEAR ALSO MUST BE INSPECTED.

F. Brush Holder Assembly

1. Test for continuity between negative brush holder and positive brush holder - both sets.
   - If continuity exists . . . Replace Brush Plate Assy. (Fig. 1, Item No. 8).

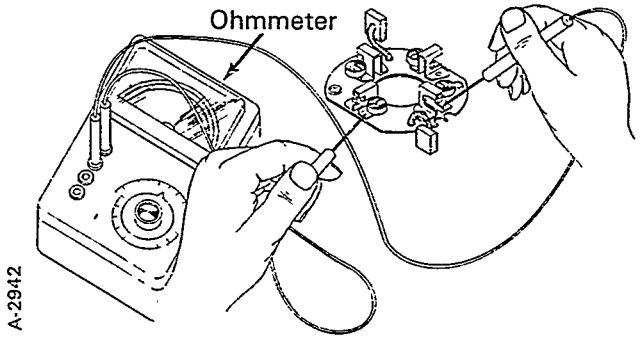

Figure 12. BRUSH HOLDER TEST

G. Armature Bearings

1. Holding outer race with finger, rotate front and rear bearings.

   • If any play or binding . . . Replace Armature Assy. w/bearings (Fig. 1, Item No. 5).

H. Magnetic Switch Solenoid Assy.

1. Run continuity test between "B" terminal and switch body.

   • If no continuity . . . Replace Magnetic Switch Solenoid Assy. (Fig. 1, Item No. 9 & 10).

2. Run continuity test between terminals "B" and "M".

   • If no continuity . . . Replace Magnetic Switch Solenoid Assy. (Fig. 1, Item No. 9 & 10).

ASSEMBLY PROCEDURE FOR REDUCTION GEAR TYPE STARTER

• Apply ASTM No. D-1743 grease to gear case and END CAP (Fig. 1, Item No. 11) at bearing housing area.

• Apply oil lightly to Pinion Drive Gear.

Proceed with re-assembly as follows:

1. Insert Pinion Drive Assy. (Fig. 1, Item No. 6 and 7) into Center Housing (Fig. 1, Item No. 12). Press firmly with fingers until drive seats into place.

2. Attach Center Housing (Fig. 1, Item No. 12) to Support Housing Assy. (Fig. 1, Item No. 19) making certain the 1/4-20 x 1-3/4 long bolt (Fig. 1, Item No. 20) is installed in the forward section of the Support Housing Assy. The two (2) 1/4-20 x 2 long bolts (Fig. 1, Item No. 23) are installed from the rear of the Center Housing.

3. Assemble the Solenoid Core into the Solenoid Assy. (Fig. 1, Item No. 9 and 10) and insert the Torsion Spring (Fig. 1, Item No. 16) into place. Set aside.

4. Place Shift Lever (Fig. 1, Item No. 15) into designated slot of the Center Housing (Fig. 1, Item No. 12) with narrow end making contact with Plunger of Pinion Drive Assy. (Fig. 1, Item No. 6 and 7.)

5. Insert Dust Cover (Fig. 1, Item No. 17) with notch at bottom rear.

6. Install assembled Solenoid Assy. (Fig. 1, Item No. 9 and 10) by placing end of Shift Lever (Fig. 1, Item No. 15) into solenoid core slot and insert looped end of Torsion Spring (Fig. 1, Item No. 16) into notch of Shift Lever. Holding in place, install 2 each solenoid Bolts and Lock Washers (Fig. 1, Item No. 30 and 31). Alternate tightening of the bolts to draw solenoid down evenly.

7. Carefully insert Armature Assy. (Fig. 1, Item No. 5) into the Field Coil Assy. (Fig. 1, Item No. 13 and 14) with drive end facing up. Rest bottom of Field Coil Assy. on table or flat surface.

8. Slide Brush Plate Assy. (Fig. 1, Item No. 8) over drive end of Armature Assy. (Fig. 1, Item No. 5.)

9. Reinstall positive (+) brushes into proper holders of the Brush Plate Assy. Seat into place and lock with springs.

10. Seat both negative brushes into place and lock in with springs.

11. Hold Field Coil Housing Assy. (Fig. 1, Item No. 13 and 14) with Armature Assy. (Fig. 1, Item No. 5) and Brush Plate Assy. (Fig. 1, Item No. 8) in place using extreme caution not to allow brushes to slip into the space between commutator and bearing ring. Install End Cap (Fig. 1, Item No. 11) over rear of Starter Motor and insert (2) each 1/4-20 x 5 Case Bolts and 1/4 Flat Washers (Fig. 1, Item No. 18) through End Cap (Fig. 1, item No. 11) and Field Coil Housing (Fig. 1, Item No. 13 and 14) into Center Housing (Fig. 1, Item No. 12) and tighten. Ascertain that new "O" Rings (Fig. 1, Item No. 29) are used between Center Housing and Field Coil Housing and between End Cap and Field Coil Housing as shown on illustration.

NOTE:

Prior to testing procedures, check the following:

Compare difference "▲" in height of pinion when it is pushed out with the Magnetic Switch energized and when it is pulled out by hand until it touches the stopper.

Difference "▲": 0.3 - .9mm
(0.012 - 0.036 in.)

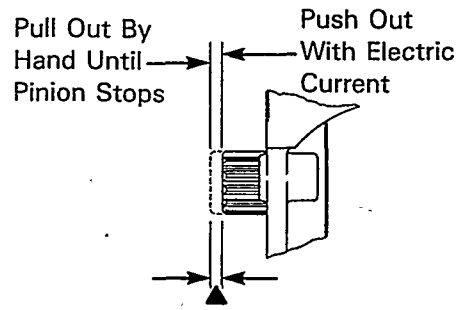

Figure 13. PINION HEIGHT

- If not in the specified value . . . Adjust by installing Shim Washer(s).

Adjusting Shim Washer Thickness:

P/N 01L21402, 0.5mm (0.020 in.)

P/N 01L21403, 0.8mm (0.031 in.)

(Fig. 1, Item No. 26 and 27.)

TESTING PROCEDURES

A. Performance Test (No-Load)

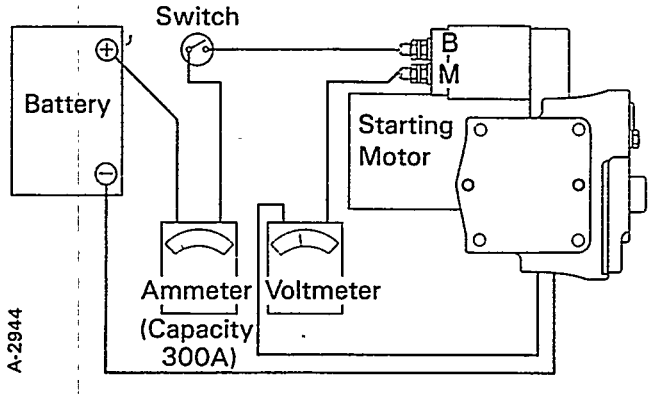

Figure 14. PERFORMANCE TEST

B. Specifications

Refer to Service Data and Specifications of Page 11 of 12.

C. Diagnosis of Test

1. Low speed with no-load and high current draw.
   a. Tight, dirty or worn bearings.
   b. Bent armature shaft or loosened field probe.
   c. Shorted armature coil.
   d. A grounded armature of field coil.
2. Failure to operate with high current draw.
   a. A grounded or open field coil.
   b. Burned out commutator bar.
      - Weak brush spring tension.
      - Thrust-out of mica in commutator.
      - Loose contact between brush and commutator.
3. Low current draw and low no-load speed.
   a. Loose connections.
   b. Dirty Commutator.
   c. Burned out commutator bar.

D. Magnetic Switch Returnability

CAUTION

DISCONNECT LEAD WIRE FROM TERMINAL "M" OF MAGNETIC SWITCH.

1. Disconnect lead wire which connects terminal "M" of magnetic switch and starter motor terminal.
2. Connect terminal "B" of magnetic switch to positive (+) terminal of battery.
3. Connect negative (—) terminal of battery to starter motor body. Plunger should be pulled in by force and the pinion gear should extend to the outboard position.
4. When either the positive (+) or negative (—) battery connections are removed from the starter, the pinion gear and plunger should return to their original positions.

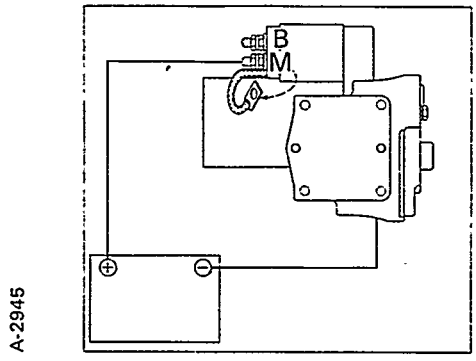

Figure 15. PINION GEAR TEST

NOTE

After testing procedures have been completed, reinstall starter on engine according to latest edition of Service Instruction No. 1447.

SERVICE DATA AND SPECIFICATIONS

Lightweight Gear Reduction Starter

Textron Lycoming Part No.			12/14	31A21198	31B21064
			10/12	31A21210	31B21211
Applied Model				Reduction Gear Type	Reduction Gear Type
System Voltage				12 v.	24 v.
No Load	Terminal Voltage			11 v.	22 v.
	Current	Amps		100	100
	Revolutions	RPMs		3900	7900
Outer diameter of commutator				29 mm	29 mm
Minimum length of brush				11 mm	11 mm
Brush spring tension				15.7-19.6 N	15.7-19.6 N
Difference in height of pinion				0.3 - 1.5 mm	0.3 - 1.5 mm

Torque Table For Starter Fasteners

Qty.	Part No.	Description	Size	Torque Ft. Lbs.
2	01B21424	Bolt, Solenoid, self-locking	M6 x 1 x 33 mm	6-7
1	LW-25-1.75	Bolt, Support Housing	1/4-20 x 1-3/4 long	6-7
2	LW-25-2.00	Bolt, Support Housing	1/4-20 x 2 long	6-7
2	31R21401	Bolt, Case	1/4-20 x 5 long	4-5
2	01B21434	Nut, Solenoid Terminal	8 mm	6-7