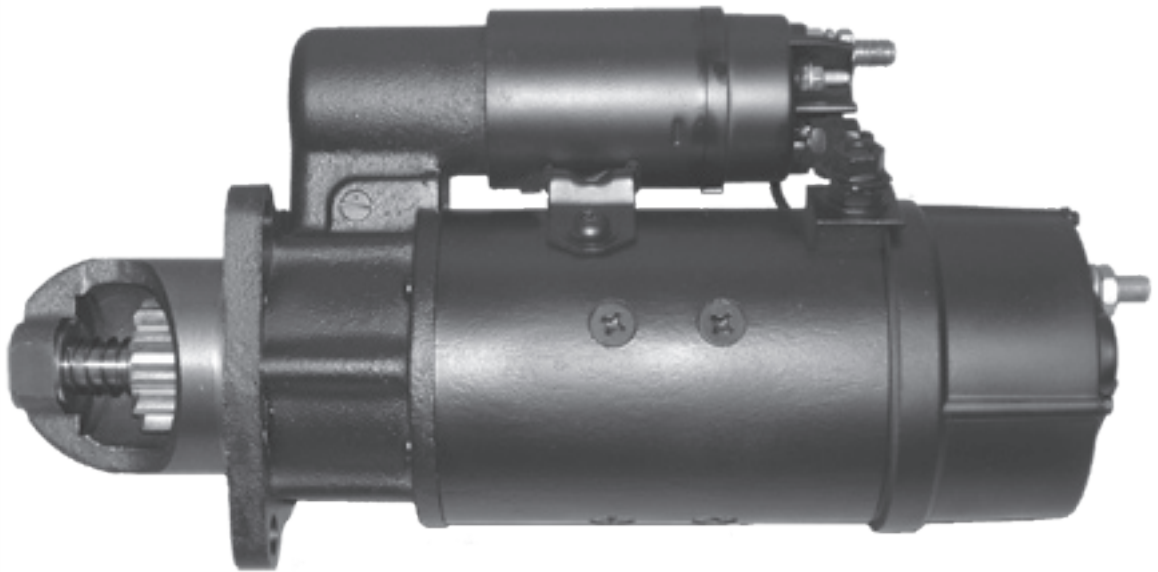




## SERVICE MANUAL FOR THE MS1 SERIES SHORT FRAME STARTER MOTOR



TROUBLESHOOTING, DIAGNOSTICS  
AND REPAIR





**SHORT  
FRAME  
MS1  
STARTER  
MOTOR  
FAMILY**



**Short Frame MS1 Starter Motor Family**

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## TECHNICAL DATA

Starter Model	MS1	MS6	MS7
<b>Output</b>	<b>9.5 HP</b>	<b>12 HP</b>	<b>11 HP</b>
<b>Lock Torque</b>	<b>10.23 KGF M 100 Nm (74 LBF FT)</b>	<b>12.86 KGF M 126 Nm 93 LBF FT</b>	<b>140 LBF FT</b>

Min. brush length	1 5.88mm(0.625in)
Brush spring pressure	1.417-1.68KGF,13.9-16.9N (50-59OZF)
Min. commutator diameter	52.39mm (2.062in)

**Armature Shaft Bush Bore  
(Reamed in position):**

Nose housing	19.10-1 9.5mm (0.752-0.754in)
(Small shaft)	15.85-15.9mm (0.624-0.626in)
Commutator end housing	19.10-19.15mm (0.752-0.754in)
Shift lever housing	22.20-22.25mm (0.874-0.876in)

**Solenoid Resistance:**

Pull-in coil	1.03-1.13 ohms @ 20 deg.C(68 deg.F)
Hold-in coil	2.3-2.55 ohms @ 20 deg.C (68 deg.F)

**Torque Wrench Settings:**

Commutator end bolts	0.635-0.754KGF M, 6.2-7.367 Nm (55-65 LBF IN)
Brush holder screw	0.16-0.20 KGF M. 1.6-2.0 Nm (14-18 LBF IN)
Shift housing to field ring screws	1.27-1.73 KGF M, 12.4-17.0 Nm (110-150 LBF IN)

**Nose Housing to Shift Housing:**

Screws	1.27-2.9 KGF M,12.4-28.3 Nm (216-250 LBF IN)
Pole shoe screws	25 LBF FT +/- 10%

### REMOVING THE SOLENOID

- (1) Disconnect the jumper lead from the solenoid terminal (4) in Fig. 1.
- (2) Remove the motor field terminal stud nuts, securing the locknut with an open ended spanner to prevent the stud from turning
- (3) Remove the two bolts holding the solenoid to the field ring assembly
- (4) Remove the nose housing.
- (5) Pull the switch back and unhook from the top of the lever arm.

### DISMANTLING THE MOTOR

**Before dismantling the motor, for ease of re-assembly make identification marks on all housings in relation to the field ring and each other by a punch or similar method.**

**During re-assembly, ensure that these marks are re-aligned.**

- (1) Remove the nut, washers and insulator from the negative terminal and undo the four fixing bolts. Take off the commutator end housing.
- (2) Undo the four brush terminal screws and remove the brushes, holding the springs out of the way with a suitable tool. Lift the brush plate assembly off of the motor.

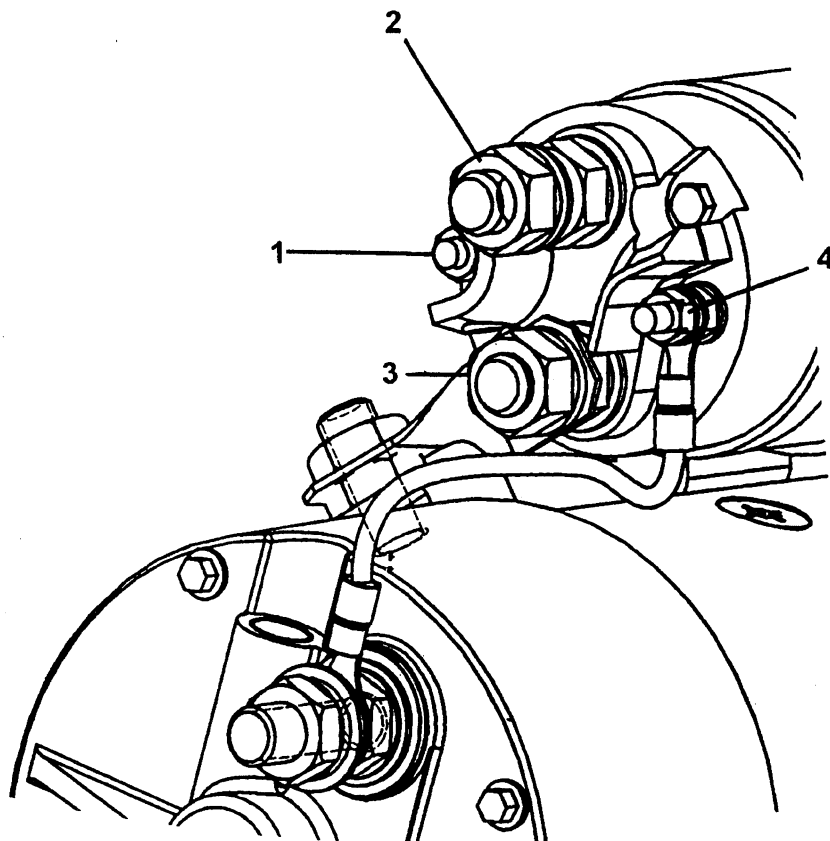


Fig. 1

- (3) Remove the six socket headed screws ( $\frac{7}{32}$ in) retaining the nose housing, using special tool Part No. GO 69019. Then slide the nose housing from the armature.
- (4) Remove the five socket-headed screws ( $\frac{3}{16}$  in) and washers from the shift housing, using special tool Part No. GO 69020. Then withdraw the shift housing complete with drive from the armature, noting the two fibre washers between the drive and shift housing (if not fitted with single brake pad).
- (5) Withdraw the armature from the field ring assembly, noting the relative positions of the steel and fibre washers at each end.

**Note: If the brush springs are to be re-used, brush spring pressure can be verified by using a spring balance. Pressure should be between 6-8 LBF at the correct height a new brush would protrude from the brush box.**

## INSPECTION, TESTING AND REPAIR

### ARMATURE

- (1) Inspect the splines and all bearing surfaces for wear or damage.
- (2) Check the armature shaft alignment with 'V' blocks or in centres. If the run out exceeds 0.127mm (0.005in), the armature must be replaced.
- (3) Inspect the surface of the commutator which should be of an even highly burnished dark copper appearance. If the surface is rough, pitted, scored, burned or coated with hard carbon then, provided that it is otherwise in a good electrical and mechanical condition, it may be skimmed on a suitable lathe. In order not to weaken the commutator or have too much clearance between the brush holders and the commutator, giving unstable brushes and weakening the spring pressure unduly, the commutator diameter must never be less than 52.375mm (2.062in).  
**Note: Under no circumstances must the commutator be undercut.**
- (4) Check the armature for earth leakage between the armature core and each commutator segment.
- (5) Check the armature for short circuits with a growler or similar equipment.
- (6) Check the armature for continuity.



**FIELD RING ASSEMBLY**

- (1) Inspect the field ring (yoke) for damage or distortion and for stripped threads or broken bolts etc. Repair or replace as necessary.
- (2) Visually examine the field coils for signs of corrosion, burning, damage etc.
- (3) Check the field coils for earthing to field ring or pole shoes and for continuity.
- (4) If field coils are to be changed, remove nut, washer, sealing ring and insulation bush. Remove the square-headed bolt from the inside of the field ring.
- (5) Unscrew the eight pole fixing screws and withdraw the poles and the windings, noting the position of the windings to facilitate re-assembly.
- (6) Thoroughly clean the yoke.
- (7) Thoroughly clean and examine the pole-pieces for damage or distortion and replace if necessary.
- (8) Fit the new windings to the pole-pieces so that they bed down as far as possible on the pole shoe wing.
- (9) Replace the coils and pole shoes into the yoke, refit the screws and tighten to 33-37 LBF FT, using a proprietary pole shoe screwdriver. There should be no space between the mating faces of the pole-pieces and the yoke.

**BRUSH PLATE ASSEMBLY**

- (1) Check for any damage, cracks or signs of fretting around the rivets or the area either side of the cut-outs for the commutator end fixing bolts.
- (2) Test the insulation between adjacent pairs of brush holders. Replace the brush holders if the reading is less than 1 megohm.

**COMMUTATOR END HOUSING**

- (1) Check for any damage, cracks or other defects.
- (2) If the bush is worn or scored, remove the plug and wick.
- (3) Remove the old bush (a  $\frac{3}{16}$ " BSF taper tap can be used as a puller).
- (4) Either; press in a new bush and, using an end drill/mill, cut the oil wick groove in the side of the bush, or slot the side of a new bush with  $\frac{3}{8}$ " round file using the old bush as a pattern, carefully line up and press in.
- (5) Set up the commutator end housing in a lathe in such a manner that when machining, the bore is perfectly concentric with the housing locating shoulder.
- (6) Turn the bearing bore to 19.152-19.10mm (0.754-0.752in) and thoroughly clean out the swarf.
- (7) Soak the felt wick with SAE 5W/20 engine oil, ease into position and fit a new plug.

### SHIFT LEVER HOUSING

- (1) Check for any damage, cracks, damaged threads or other defects.
- (2) Remove the locknut and unscrew the pivot pin.
- (3) If the shift housing bush is worn or scored, remove the old bush and oil seal.
- (4) Press in a new oilite bush and fit oil seal.
- (5) Refit or renew the shift lever arm. grease the middle portion and 'O' ring and replace the shift lever pivot pin. Put the lock washer and nut on finger tight (this will be tightened during the timing procedure).

### NOSE HOUSING

- (1) Check for any damage, cracks, distortion, damaged threads or other defects.
- (2) If the bush is worn or scored, remove the plug and wick.
- (3) Remove the old bush.
- (4) Either; press in a new bush and, using an end drill/mill, cut the oil wick groove in the side of the bush, or slot the side of a new bush with  $\frac{3}{8}$ " round file using the old bush as a pattern, carefully line up and press in.
- (5) Set up the nose housing in a lathe in such a manner that when machining, the bore is perfectly concentric with the nose housing locating shoulder.
- (6) Turn the bearing bore to 19.152-19.10mm (0.754-0.752in) and thoroughly clean out the swarf. (Small shaft motors 15.85-15.9mm [0.624-0.626in]).
- (7) Soak the felt wick with SAE 5W/20 engine oil, ease into position and refit the plug.

**TORKDRIVE UNIT**

**The torkdrive unit contains a special lubricant and must not be immersed in cleaning fluid.**

The unit incorporates a helix drive that will index the pinion half of one tooth width to ensure that engagement takes place on the second attempt if tooth abutment occurs on initial engagement. The unit also incorporates a ratchet clutch separator device. When the engine starts firing, firstly the pinion will ratchet in relation to the armature and then, whenever the speed exceeds approximately 11,000 RPM, the pinion to armature connection is completely disengaged.

- (1) Check for damage or wear to pinion teeth and to rest of the unit,
- (2) Check that the pinion slides inwards against spring pressure on it's helix drive and that the ratchet operates,

**Note: Torkdrive units are not repairable. In the event of any damage or malfunction the complete unit must be renewed.**

### MOTOR RE-ASSEMBLY

#### **Ensure that all components are thoroughly cleaned before re-assembly**

All sealing "O" rings should be lubricated with grease and the bearing bushes smeared with clean SAE 5W/20 engine oil prior to assembly. Fibre washers and felt wicks should be soaked with SAE 5W/20 engine oil.

- (1) Place a steel thrust washer followed by a fibre washer on the commutator end of the armature shaft and place the shaft into position in the field ring assembly.
- (2) Place a steel thrust washer and then a fibre washer onto the splined end of the shaft and lubricate the splines and the shaft with Texaco Ultratemp or Part No 851662.
- (3) Fit a new "O" ring seal to the shift housing. Grease both shift lever cam pivots if of the loose type with flat sides. Slide the shift housing just onto the armature shaft, install two fibre washers if there is no brake pad in the housing. Engage the cams into the collar of the torkdrive and slide the complete assembly along the shaft to the field ring. Using new spring washers and with Loctite 242 on the threads, replace the five socket headed screws and tighten to 1.27-1.73 KGF M, 12.4-17.0 Nm (110-150 LBF IN).
- (4) Fit the brush plate assembly over the commutator, locating it on the pins. Insert the brushes, ensuring that the springs sit squarely on the back of the brush. Fit the screws through the brush terminals and jumpers, and tighten to the required torque (see data). Ensure that the negative jumper and bolt are correctly orientated to suit the commutator end casting. Fit the insulator on the terminal, and place the commutator end casting onto the motor after fitting a new "O" ring seal inside the casting.
- (5) Ensure that the casting is properly aligned and fit the four fixing bolts with new sealing washers. Tighten to the required torque (see data).
- (6) Fit the "O" ring seal, the insulator and washers over the negative terminal and tighten the nut to 15 LBF FT.
- (7) Hook the solenoid over the top of the shift lever (it will be necessary to hold the drive forward to keep the top of the lever far enough back) and slide the nose of the solenoid into the shift housing, placing the copper jumper over the field and switch studs. Fit the two retaining bolts and tighten to 300-350 LBF IN.
- (8) Place the steel washer(s) and/or spring on the armature shaft. Fit a new "O" ring to the nose housing and refit using six new screws with lockpatch. Tighten evenly to 1.27-2.9 KGF M, 12.4-28.3 Nm (216-250 LBF IN).

## TEST PROCEDURE

- (1) Connect a 24 volt supply to the switch terminals 1 and 3 (see Fig. A). With the solenoid switch energised, gently push back the drive assembly against the shift arm cams. Check the spacing between the face of the pinion and thrust washer, using special tool Part No. GO 14001 (or special tool Part No. CEG 14/110 for the spring version), is 4.76 mm (0.187 in) thick, or 8.74 mm (0.344in) for the spring version. (see Fig. B).

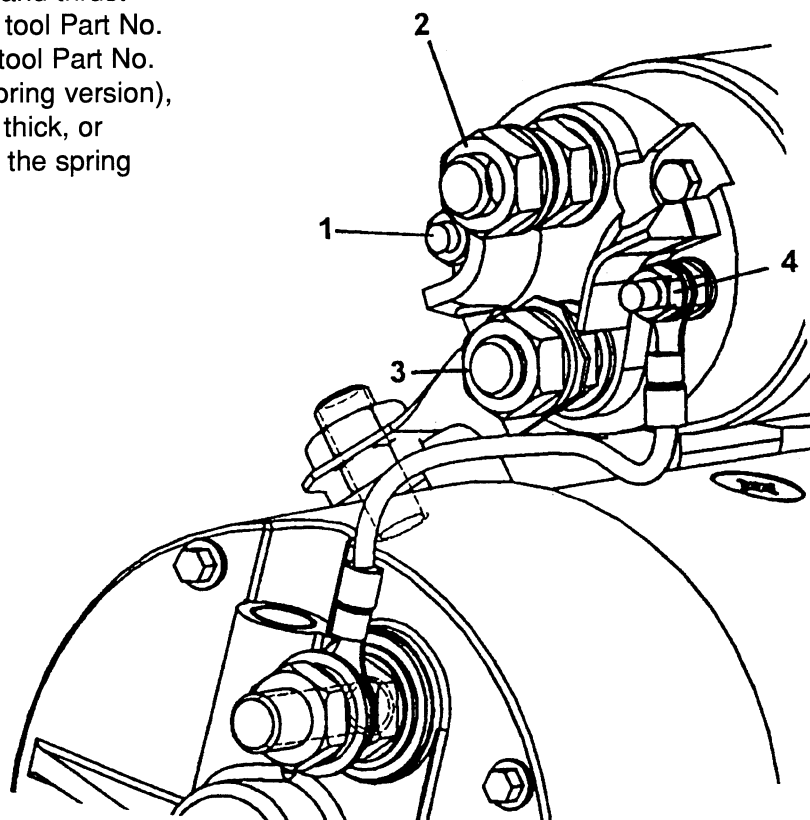


Fig. A Solenoid Terminals

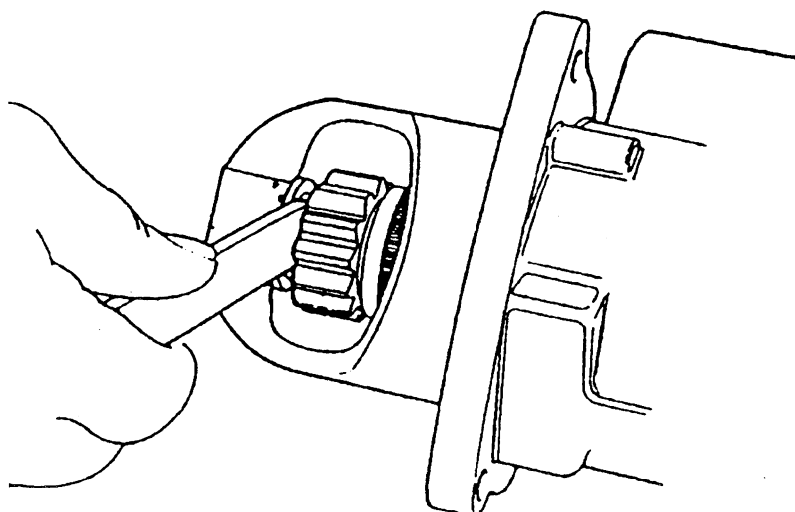


Fig. B Checking Pinion/ Thrust Washer Gap

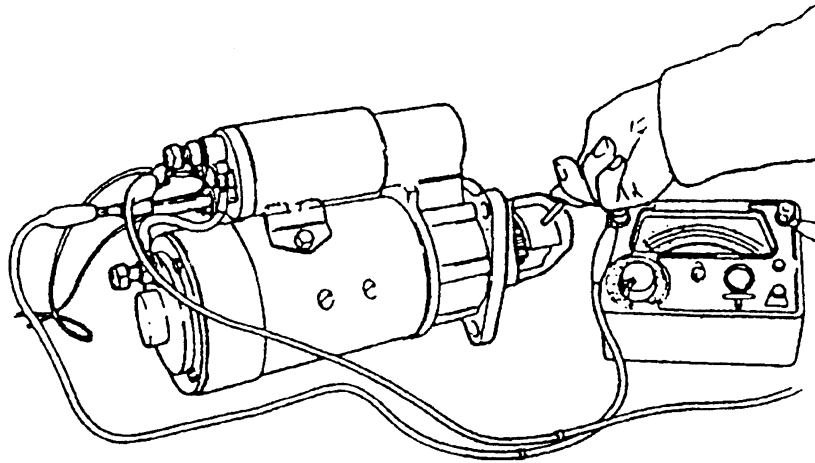
## TEST PROCEDURE

- (2) If adjustment is necessary, turn the pivot pin clockwise or anti-clockwise until the gauge is a sliding fit between the pinion and thrust washer when the switch is again energised.

**Note: The adjustment must not be made with the switch energised. Never leave the switch energised for more than 30 seconds.**

- (3) Test the solenoid switch for the correct operating sequence by placing special tool Part No. GO 14003 (or special tool Part No. CEG 14/109/2 for the spring version) on the pinion shaft to retain the drive in the rest position. With a continuity meter connected across terminals 2 and 3, connect a 24 volt supply across terminals 1 and 3 when no continuity should be observed across terminals 2 and 3. (see Fig. C)

- (4) After adjustment, tighten the locknut to 30 LBF IN, applying loctite between nut and housing.



**Fig. C Abutment Test**

**REAMER KIT FOR PRESTOLITE STARTER MOTORS**

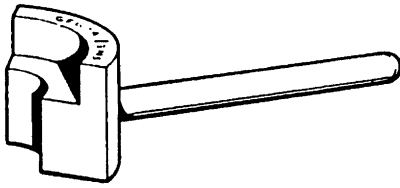
<b>1 x <math>\frac{3}{4}</math> in Reamer:</b>	Non-adjustable, shortened by $\frac{1}{2}$ in on the cutting edge for C/E bush (lead-in removed).
<b>1 x <math>\frac{3}{4}</math> in Reamer:</b>	Non-adjustable, for D/E bush.
<b>1 x <math>\frac{7}{8}</math> in Reamer:</b>	Non-adjustable for shift housing bush.
<b>1 x <math>\frac{13}{14}</math> in BSF Taper Tap:</b>	To remove old C/E bush
<b>3 x 1 and <math>\frac{1}{8}</math> in 14 in Mild steel bar</b>	

Bore out bars to take Reamer shaft, drill and tap to take Allen screws to hold Reamer, and drill opposite end to take handle bar. Clean down the bars to clear shift housing minus bush.

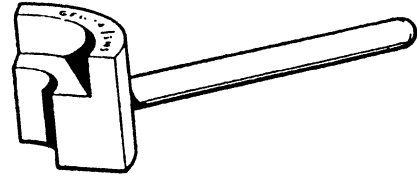
Bore out spare D/E bracket to give clearance on bar.

- (1) To ream C/E bush, slot the bush with a round file and press in. Assemble the C/E bracket. Ream with the  $\frac{3}{4}$  in shortened Reamer.
- (2) To ream D/E bracket bush, slot bush with a round file and press in. Bolt the housing to the shift housing (less bush) and ream to size with long  $\frac{3}{4}$  in Reamer.
- (3) To ream the shift housing bush, slot bush with a round file and press in. Bolt the bored-out nose housing to the shift housing and ream to size with  $\frac{7}{8}$  in Reamer.

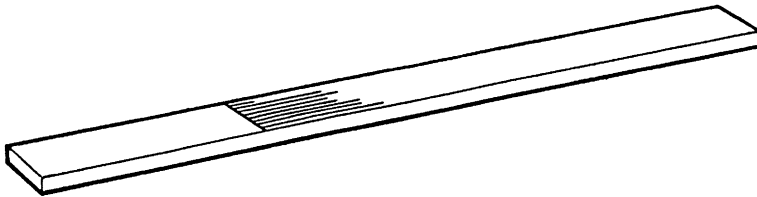
**SPECIAL TOOL**



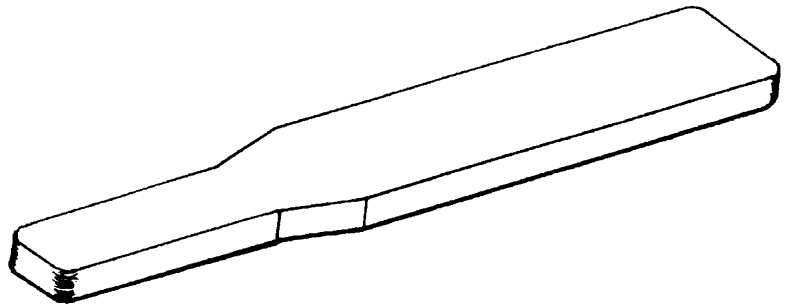
**Abutment gauge GO 14003 used on abutment test**



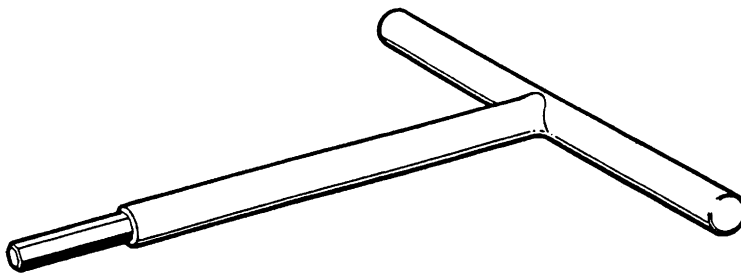
**Abutment gauge CEG 14/109/2 used on abutment test for spring version**



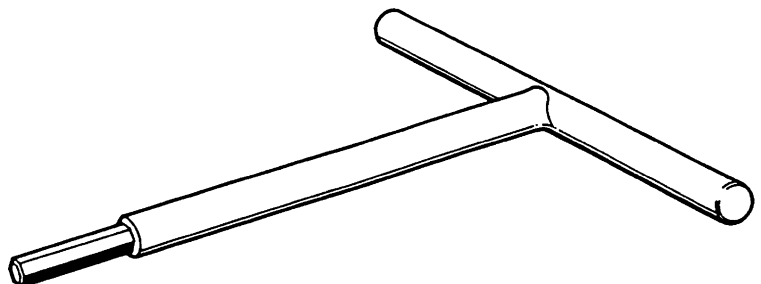
**Timing gauge GO 14001 used for setting pinion clearance**



**Timing gauge CEG 14/110 used for setting pinion clearance on the spring version**



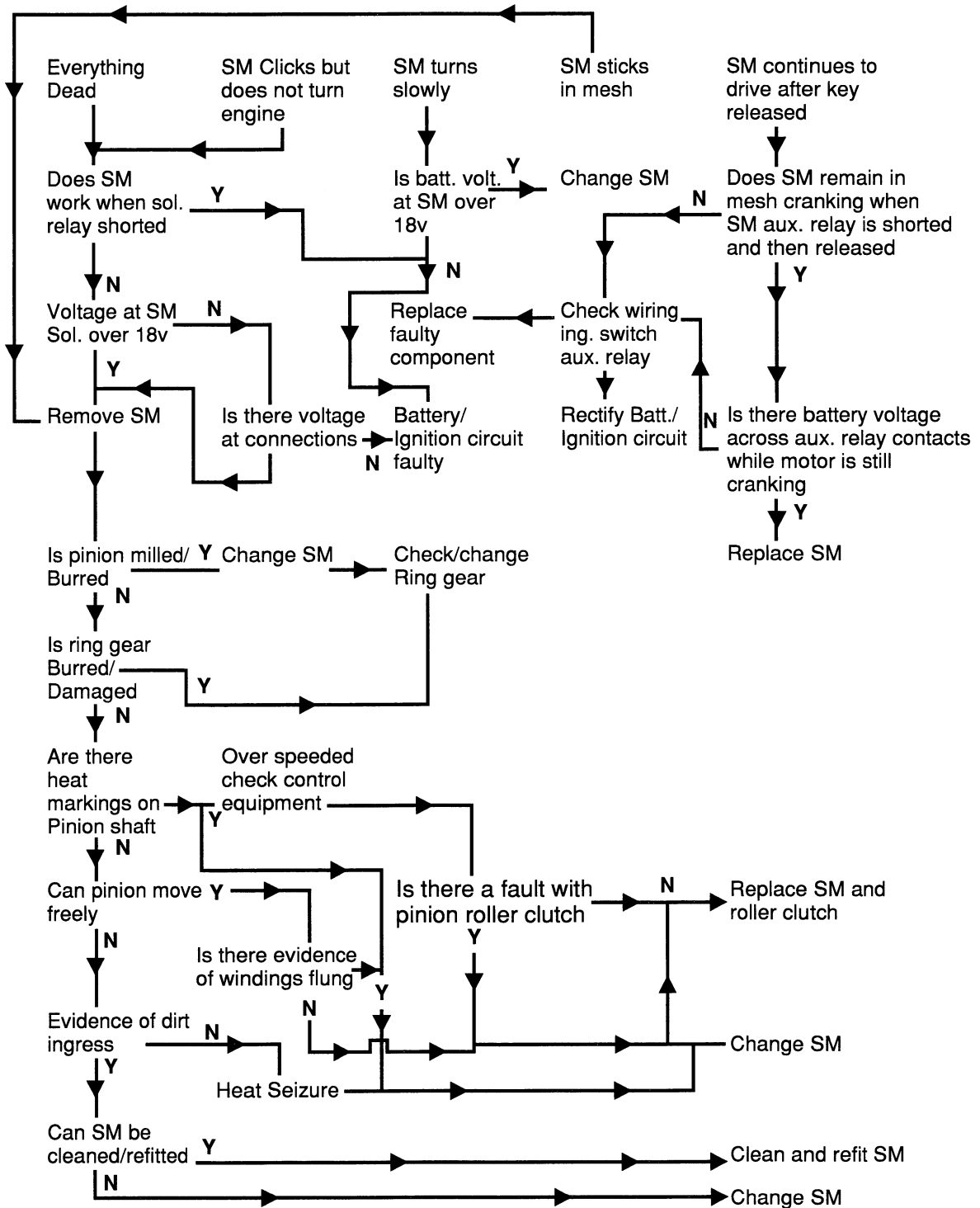
**Tee wrench GO 69019 facilities removal of nose housing screws**



**Tee wrench GO 69020 facilities removal of nose housing screws**



# STARTER MOTOR TROUBLE SHOOTING FLOW CHART



**Y = YES**  
**N = NO**  
**SM = Starter motor**