SHOP TIPS FROM Autolite

VOL. 6, NO. 12 AUGUST, 1968

Servicing the New...

Autolite HIGH PERFORMANCE unifill battery

Technical parts and service information published by the Autolite-Ford Parts Division and distributed by Ford and Lincoln-Mercury dealers to assist servicemen in Service Stations, Independent Garages and Fleets.

PLUS...

STARTER OVERHAUL AND NEUTRAL START SWITCH ADJUSTMENT

Autolite HIGH PERFORMANCE unifill battery

IN THIS ISSUE

Be sure and file this and future bulletins for ready reference. If you have any suggestions for additional information that you would like to see included in this publication, please write to: Autolite-Ford Parts Division of Ford Motor Company, Merchandising Services Dept., P.O. Box 3000, Livonia, Michigan 48151.

The description and specifications contained in this book were in effect at the time the publication was approved for printing. The Ford Motor Company, whose policy is one of continuous improvement, reserves the right to discontinue models at any time, or to change specifications or design without notice and without incurring obligation.

Autolite Ford

VOL. 68 FPM 114 LITHO IN U.S.A.

ESPECIALLY DESIGNED FOR TODAY'S HIGH PERFORMANCE DRIVING

This is a brand new line of batteries from Autolite, incorporating all the quality features of Ford's Original Equipment battery, plus new high performance capacity and exclusive new "unifill" feature. Motorists get more starting power . . . with more power in reserve, and minimum maintenance is required. In short, this is the battery to recommend for *rugged reliability and extra high performance!*

FEATURES . . .

• *New Unifill Design* developed by Ford Motor Company includes unique single point checking and maintenance. You simply open one door to check fluid level or service the entire battery.

Figure 1—Unique Unifill Gold Door

• *New Through-The-Wall Connectors* minimize internal electrical resistance for higher starting voltage, peak power output; to achieve higher levels of performance.

• *Ford-Engineered Separators* feature newly designed, thicker backweb for improved resistance to shorting . . . more power and increased service life.

• *One Piece Cover,* Autolite's most copied feature, is epoxy sealed to the case . . . eliminates self discharging at top . . . no exposed parts . . . easier to clean and also stronger.

• *Vibration Guarded* patented construction leaves no room for vibration. Elements are epoxy bonded to bottom of case to withstand shock and vibration which are the principal causes of early battery failure.

AUTOLITE HIGH PERFORMANCE BATTERY LINE SPECIFICATIONS

Volts	Group Numbers	Autolite Type	No. Of Plates Per Cell	20 Ampere Hour Rating AABM	300 Amps. @ 0° F.	
					No. Of Minutes	All 12 Volt 10 Sec. Volt
12	24C	HVU-24C	13	73	2.4	8.5
12	24F	HVU-24F	13	73	2.4	8.5
12	27C	HVU-27C	13	75	2.4	8.5
12	27HF	HVU-27HF	13	80	2.8	8.5
12	29HR	HVU-29HR	15	85	3.5	9.0

SERVICING AUTOLITE'S NEW HIGH PERFORMANCE unifill BATTERY

IMPORTANCE OF PROPER SERVICE

Autolite's new High Performance battery has been engineered to the highest reliability and performance standards in the industry. The Unifill Battery incorporates a unique filling mechanism designed for ease of battery maintenance. Many batteries never achieve their maximum service life because of the lack of proper service. We encourage you to take a few minutes to learn about the operation of the "Unifill" feature. By following the few simple instructions, you can expect to achieve longer battery service life.

OPERATING PRINCIPLE OF THE UNIFILL FEATURE

A diagram of the Unifill filling assembly and the component parts is illustrated in Figure 2. The Unifill feature assures automatic, consecutive filling of all cells to their recommended level. The Unifill battery filling mechanism utilizes air entrapment (or air-lock) in the upper battery cell segments as its basic operating principle. When sufficient liquid is added to a cell to seal off further air escapement from the normal vent-well opening, the liquid continues to rise in the well until it overflows into the adjacent cells. In this way, all six vent-wells in the connecting channel are filled. When the Unifill door is closed, a cam-actuated release mechanism opens an air escapement vent to each cell enabling all cells to vent freely to the atmosphere. This allows the liquid remaining in the cover channel and vent-well columns to displace the escaping air by receding uniformly into each cell at the correct, predetermined fill level.

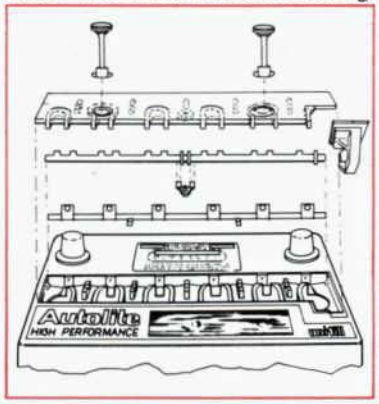


Figure 2—Unifill Battery Filling Mechanism

INITIAL ACTIVATION PROCEDURE

1. Lift gold Unifill door to its maximum open position. Opening the door operates a camshaft which forces baffles against the vent holes thus forming an air-lock in the upper battery cell segment.
2. Pour electrolyte into the filler opening beneath the door at a slow but steady rate until the top channel is completely filled and electrolyte reaches and stays at the "level" mark in the Unifill door opening.
3. Close gold-colored Unifill door. This allows the air in the upper cell segment to escape and permits the electrolyte in the channel to recede into the cell openings to the proper fill level. The fluid level in each cell should now cover the split-ring.

INITIAL CHARGING PROCEDURE

The charging procedure, as detailed on the instruction sheet packed with the battery, is the same for the High Performance Unifill as specified for all other Autolite batteries—except for venting provisions. To provide proper venting, it is important that the *gold colored Unifill door remains in a closed position during the charging operation.*

PERIODIC MAINTENANCE

After the battery has been placed in service, it should be checked at regular intervals to assure that the fluid level is maintained so as to cover the bottom of the split-ring in the filler door opening. If it becomes necessary to add water, the following procedure should be followed:

1. Water of acceptable chemical content should be used to maintain the fluid level. Never add acid.
2. Open the gold-colored Unifill door and add water at a steady rate until the top channel is filled and water reaches and stays at the "level" mark in the Unifill door opening (Fig 3).
3. Slowly close the Unifill door. This will release the water being suspended over each cell and allow it to drain into the cell compartments.

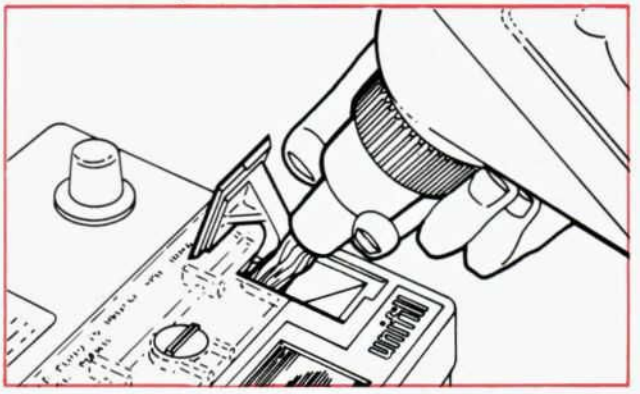


Figure 3—Adding Water To Unifill Battery

CAUTION: DO NOT REPEAT THIS CYCLE. IT CAN RESULT IN OVER-FILLING THE BATTERY.

TESTING THE HIGH PERFORMANCE UNIFILL BATTERY

All recommended Autolite battery tests which are made by attaching test instruments to the terminal posts can be performed on the High Performance Unifill Battery. To perform tests involving individual cell comparisons (specific gravity, open circuit voltage, etc.) it will be necessary to remove the Unifill cover. This may be done by simply turning the two retainers 90° either direction. The complete Unifill cover may now be removed from the battery and all cells will be exposed. It is not recommended, that the Unifill cover be removed unless it is absolutely necessary for testing purposes.

NEUTRAL START SWITCH ADJUSTMENT

INTRODUCTION

All vehicles equipped with an automatic transmission use a neutral start switch. It prevents the engine from starting except when the transmission lever is in the "N" (Neutral) or "P" (Park) position. *Never,* under any conditions, should the engine start in drive or reverse. If this happens, or if it's necessary to "hunt" for the proper lever position in neutral or park, the neutral start switch probably requires adjustment. Failure to start in any position when the switch is properly adjusted can be caused by an electrical or mechanical defect in the switch or starter system. Correcting this type of problem was covered in the July 1968 issue of Shop Tips. This article explains how to diagnose and correct maladjusted neutral start switches. Most of it deals with the redesigned switch used on 1968 column shift models.

SWITCH ADJUSTMENT (CONSOLE SHIFT) 1966-68 MODELS

1. With the manual linkage properly adjusted, check the starter engagement circuit in all positions. The circuit must be *open* in all drive positions, and *closed* to allow current to flow only in Park and Neutral.
2. Pull away the carpet and remove the screws and plates necessary to remove the console selector lever handle and detent control from the vehicle.

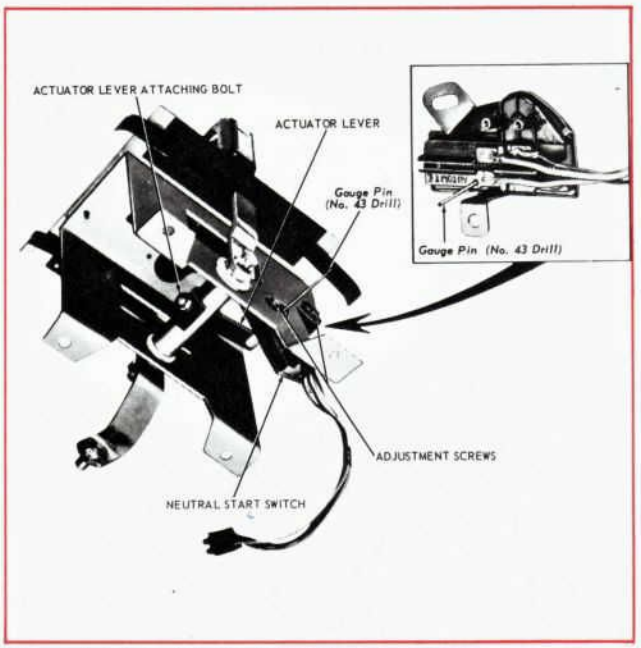


Figure 1—Typical Neutral Start Switch Adjustment Ford-Mercury Shown—Others Similar

3. Loosen the two combination starter neutral and back-up light switch attaching screws (Fig. 1).
4. Move the selector lever back and forth until a gauge pin (#43 drill, or 0.0937-inch diameter rod) can be fully inserted into the gauge pin holes.
5. Move the transmission lever firmly against the stop of the neutral detent position.
6. Slide the combination starter neutral and back-up light switch forward or rearward as required, until the switch lever contacts the selector lever actuator. If an adjustment can not be made by rotating the switch, loosen the acuator lever attaching bolt and adjust the lever.
7. Tighten the neutral start switch attaching screws. If the actuator lever was adjusted, tighten the actuator lever bolt.
8. Turn the ignition key to the ACC position, move the transmission lever to reverse, and check back-up light operation. Turn off the key.
9. Re-install the selector lever handle, detent control and console, then tuck under the carpet.

NOTE (MUSTANG-COUGAR ONLY): When the two neutral start switch attaching bolts are loosened and the transmission lever is in neutral, the switch must be rotated until the No. 43 gauge pin can be inserted to a *full* 31/64 inch through the *three* holes of the switch (Fig. 2).

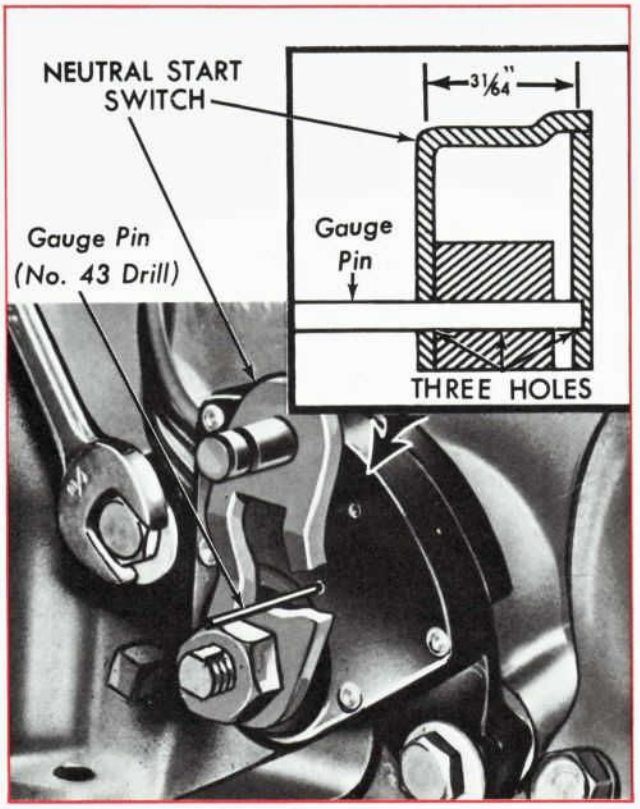


Figure 2—Neutral Start Switch—Mustang/Cougar

SWITCH ADJUSTMENT (COLUMN SHIFT) 1966-1967 MODELS

1. With the manual linkage properly adjusted, check the starter engagement circuit in all transmission selector lever positions. The circuit must be open in all drive positions and closed only in Park and Neutral. The starter should engage only in Park or Neutral.
2. To adjust the switch, loosen the retaining screws that locate the switch on the steering column.
3. Move the transmission selector lever firmly against the stop of the neutral detent position.
4. Rotate the switch actuating lever until the guage pin

NEUTRAL START SWITCH ADJUSTMENT

(No. 43 drill) can be inserted into the gauge pin holes (Fig. 3).

5. Tighten the two switch retaining screws and remove the pin.
6. Check the operation of the switch in each selector lever position. The starter should engage in *only* the neutral and park detent positions.

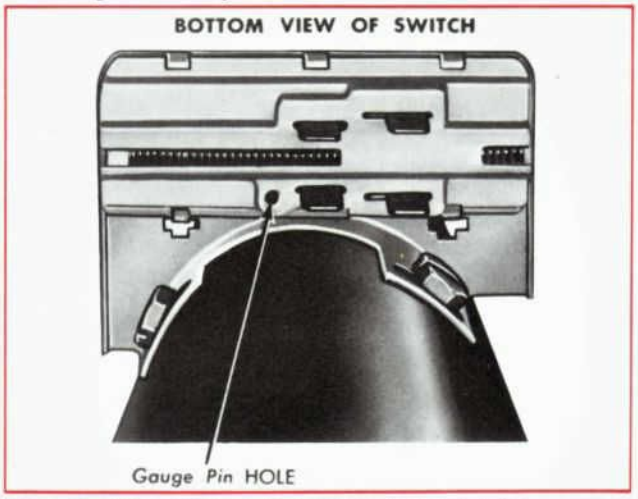


Figure 3–Neutral Start Switch–1966-67 Models With Column Shift

NEW COLUMN MOUNTED NEUTRAL START SWITCH FOR 1968 MODELS

1968 models use a completely redesigned neutral start switch for column shift vehicles. It is still mounted on top of the steering column jacket, but is now located nearer the toeboard–just below the collapsible section of the jacket. A new self-adjusting park circuit requires a special adjustment procedure to provide correct operation. The self-adjusting feature consists of a ratcheting device that allows a variable angle between the neutral and park starting positions. This angle was always held constant on past models. Because of the angle variation between park and neutral, it is no longer possible to adjust the switch by simply loosening the switch and using ONE locating pin, or rotating the switch around the column to get a proper adjustment, as with 1967 and prior models. To do so will create a "hunting" condition in Park or Neutral positions on 1968 vehicles. Therefore, a new procedure must be used to provide the correct adjustment.

The Diagnostic Guide on page 6 will help in trouble shooting neutral start switch problems.

TWO TYPES OF 1968 SWITCHES

Figure 4 illustrates the column mounted switches used on 1968 vehicles. "A" switches incorporate an integral actuator lever switch. Some type "A" switches also have connections for cars equipped with vacuum operated parking brake release systems (left-most switch). Type "A" switches make use of two gauge pinning holes (A) for Park and (B) for Neutral. Type "B" switches have a common Park and Neutral gauge pinning hole. Type "B" switches also have a separate actuator lever switch.

Type "A" and "B" neutral start switches can be used interchangeably. However, when replacing a separate actuator lever switch with an integral lever switch, the separate actuator lever must be removed from the column (Fig 5). Similarly, when replacing an integral actuator lever switch with one that has a separate actuator lever, the separate lever must be inserted in the column as shown in Figure 5.

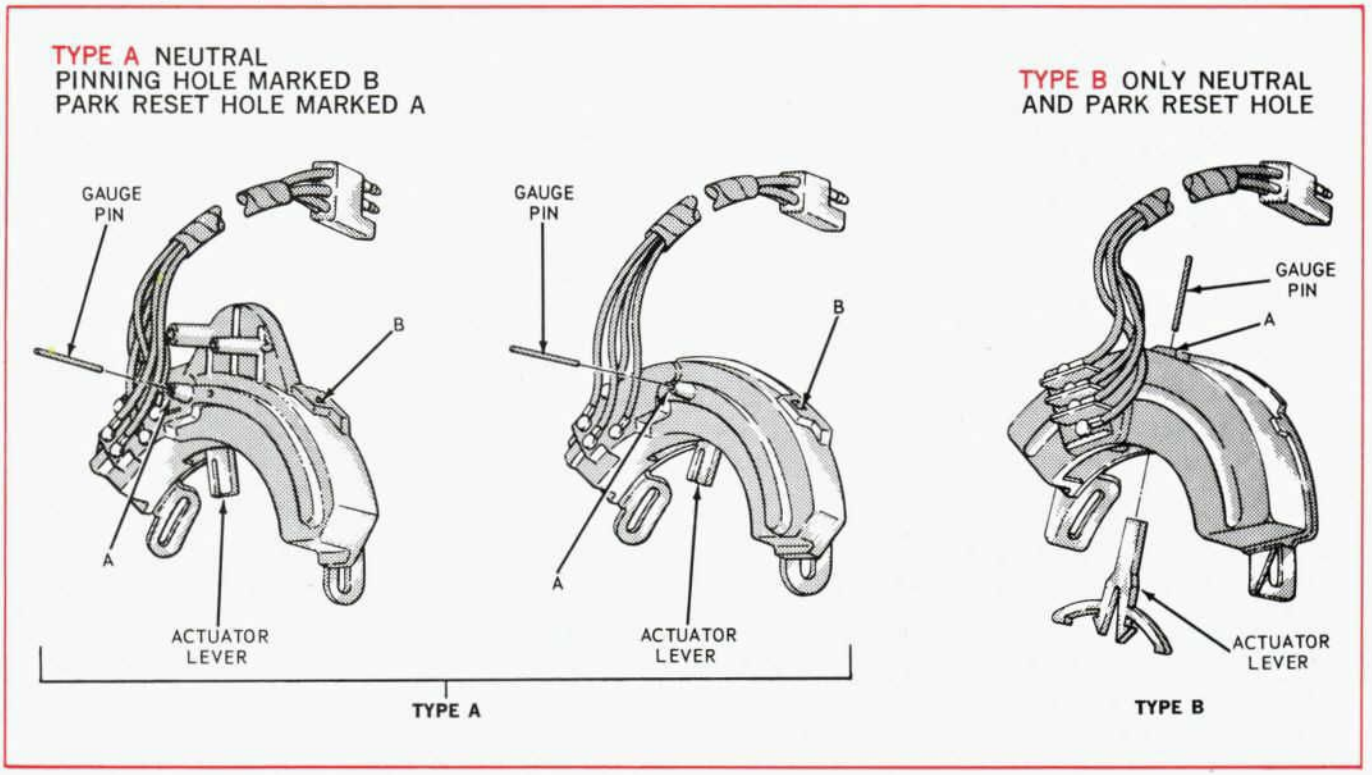


Figure 4–Column Mounted Neutral Start Switches–1968 Vehicles

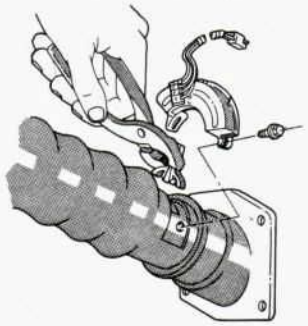
NEUTRAL START SWITCH ADJUSTMENT

NEUTRAL START SWITCH PROBLEM DIAGNOSIS

NOTE: Verify complaint and insure correct column alignment and shift linkage adjustment before attempting to adjust neutral switch.

CONDITION	POSSIBLE CAUSE	CORRECTION
Hunt to Start In Park or Neutral	• Switch out of adjustment	Re-adjust switch (see switch adjustment procedure).
	• Loose or stripped attaching screws	Re-adjust switch and torque attaching screws to 13-17 lbs. inch.* If screws are stripped, replace with #12 x ¼" sheet metal screws torqued to 12-14 lbs. inc.* The replacement screws **must not** be longer than ¼ inch or a shift tube binding condition will result.
	• Switch Malfunction	Replace switch.
	IF AFTER ATTEMPTING THE ABOVE, THE SWITCH WILL NOT HOLD ITS ADJUSTMENT, CHECK FOR THE FOLLOWING:	
	• Loose flange casting to outer tube nuts (fixed column)	Rotate the flange casting counter clockwise by applying force to the transmission selector lever upward against the Park stop and torque the nuts (see Figure 11) to 70-80 lbs. inch*, then re-adjust switch.
	• Loose or broken insert plate	Fixed Column—replace the insert plate if it is broken or cracked. If the insert plate is not damaged but can be moved with relation to the flange casting, torque the attaching screws to 12-17 lbs. inch* and stake the insert plate to the flange casting (see Figure 12). Tilt Column—to gain access to the insert plate drive out the roll pin and remove the shift lever. Insert a screw driver through the shift lever hole and tighten the detent plate attaching screws.
Starts in Drive or Reverse	• Maladjustment of switch	Properly adjust switch (see switch adjustment procedure).
	• Broken or damaged actuator lever	Replace lever (Type B switch), replace Type A switch (see Figure 4).
	• Loose or stripped attaching screws	See above.
No start in any Position with Switch Properly Adjusted	• Vehicle electrical or ignition system needs repair	Correct as required. Also, assure that the hard shell connector attached to the back of the ignition switch is properly seated.
	• Electrical portion of neutral switch inoperative (inspect for continuity in Park or Neutral position)	Replace switch.
	• Mechanical portion of neutral switch inoperative (internal)	Replace switch.
	• Broken or damaged actuator lever	Replace lever (Type B switch), replace Type A switch (see Figure 4).

*The torque measurements given above are critical, over or under tightening will result in subsequent damage to the part and reoccurrence of the problem.



REMOVAL AND INSTALLATION OF TYPE B SWITCH ACTUATOR LEVER

Fig. 5—Separate Actuator Lever for Type "B" Switches

SWITCH ADJUSTMENT (COLUMN SHIFT)—1968 MODELS

Do not attempt to adjust the 1968 model neutral start switch by merely loosening the attaching screws and rotating the switch on the column. A "hunting" condition may result unless the following 1968 procedure is adhered to.

In some cases, a failure to start in Neutral may be caused by maladjusted shift linkage. To test: hold the shift lever *lightly* against the neutral stop, and attempt to start. If engine starts, adjust shift linkage. If no start, the switch must be adjusted, per instructions on page 7.

NEUTRAL START SWITCH ADJUSTMENT

Figure 6-A—Removing Switch From Column—Type "A" Switch

Figure 7-A—Moving Type "A" Switch Lever To Far Left

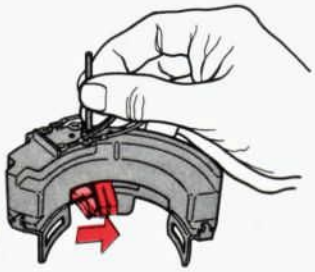


Figure 8-A—Inserting Pin In Type "A" Switch And Moving Lever To Right

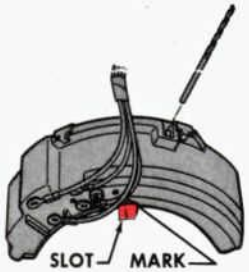


Figure 9-A—Aligning Carrier Slot With Mark On Switch

1. Set the parking brake and place the transmission selector lever in Neutral.
2. Disconnect the electrical connector to the switch (and disconnect the vacuum hoses on models so equipped).
3. Remove the two attaching screws and gently lift the switch upward from the column (Figs. 6A & 6B). Do not remove the actuating lever from the column on those switches with the separate actuating lever (Type B, to avoid possible breakage.
4. Holding the switch in the same direction as installed on steering column (with the wire terminal facing you) move the actuator lever all the way to your left on Type "A" switches (Fig. 7-A). On the Type "B" switch, use a small screwdriver or other blunt instrument to move the switch carrier to the left (Fig. 7-B). This will enable you to insert a gauge pin into the proper hole to reset the park racheting device.
5. ON A TYPE "A" SWITCH, insert a 1/16-inch diameter pin or drill into the tapered round boss facing you (Fig. 8-A). Move the actuator lever (switch carrier) to the right until it stops. ON A TYPE "B" SWITCH, insert a gauge pin (No. 43 drill, or 0.089" dia. rod) into the hole in the boss on top of the switch (Fig. 8-B). Be careful not to insert the pin farther than ½-inch. Using the tool as in Fig. 7-B, move the carrier to the right until it stops.
6. Remove the gauge pin or drill. Move the actuator lever (switch carrier) toward center of switch until hole in lever lines up with mark on Type "A" switches, (Fig. 9-A), or top hole in type "B" switches (Fig. 9-B). Install the gauge pin or drill in the neutral pin hole on the top of the switch. To insure that the pin is correctly placed, attempt to move the switch carrier; you should *not* be able to move it.
7. With the gauge pin or drill in place, and the transmission selector lever held firmly upward against the stop in the neutral detent position, install the switch on the steering column (Figs. 10-A & 10-B). (On type "B" switches, be sure the actuator lever in the column properly engages the switch carrier.) Continue to hold the shift lever against the Neutral stop and tighten the two attaching screws to 16 inch pounds torque. The switch now should be properly adjusted.
8. REMOVE THE GAUGE PIN OR DRILL. Re-connect the electrical connector (and vacuum lines, if so equipped). Operate the selector lever and test for start in Neutral and Park. The vehicle should start with the selector lever held against the Neutral stop and with the selector lever in its *natural* neutral position.

   If not, loosen the attaching screws, replace the pin in the neutral pinning hole and with the selector lever held firmly against the Neutral stop, torque the attaching screws to 16 inch pounds, *being careful not to allow the switch to move with respect to the column.*
9. Remove the gauge pin and place the transmission selector in the Park position. The switch racheting device will automatically adjust to the Park detent. Attempt to start the vehicle in the Park position without "hunting." If a "hunting" condition is encountered, refer to the Diagnosis Guide.
10. Attempt a start in Drive and in Reverse. The engine *must not start* in either position.

Figure 6-B—Removing Switch From Column—Type "B" Switch

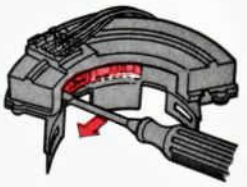


Figure 7-B—Inserting Tool In Left Slot Of Type "B" Switch

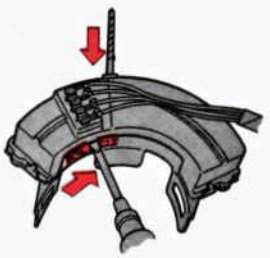


Figure 8-B—Inserting Pin In Type "B" Switch And Moving Carrier To Right With Tool

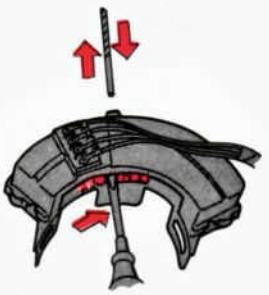


Figure 9-B—Aligning Hole In Carrier With Hole On Top Of Switch

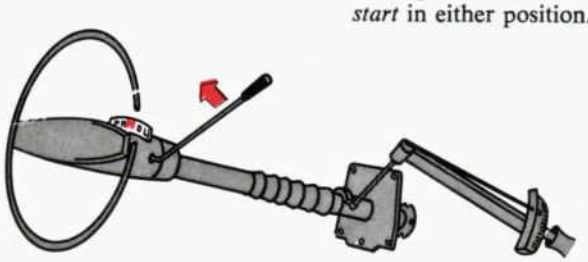


Figure 10-A—Installing Type "A" Switch

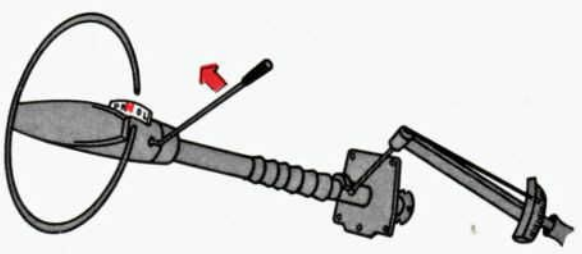


Figure 10-B—Installing Over Actuator In Column Type "B" Switch

NEUTRAL START SWITCH ADJUSTMENT

DETENT PLATE REPAIR

Occasionally, a loose or malformed detent plate may cause a neutral start problem. To gain access for the removal and replacement, or staking operation of the detent (index) plate, the following procedure is recommended:

Removal

1. Disconnect the battery.
2. Remove the steering wheel assembly.
3. Remove the protective wire cover from the column.
4. Disconnect the turn signal switch electrical connector plug.
5. Remove the turn signal lever.

   NOTE: Do not separate the lever and switch wires at this time on speed control equipped vehicles.
6. Remove the turn signal switch screws (3) and pull the wires up enough to permit access to the detent flange retaining screws (Fig. 11).

   NOTE: Flange retaining nut torque may be checked at this point—must be 70-80 inch pounds.

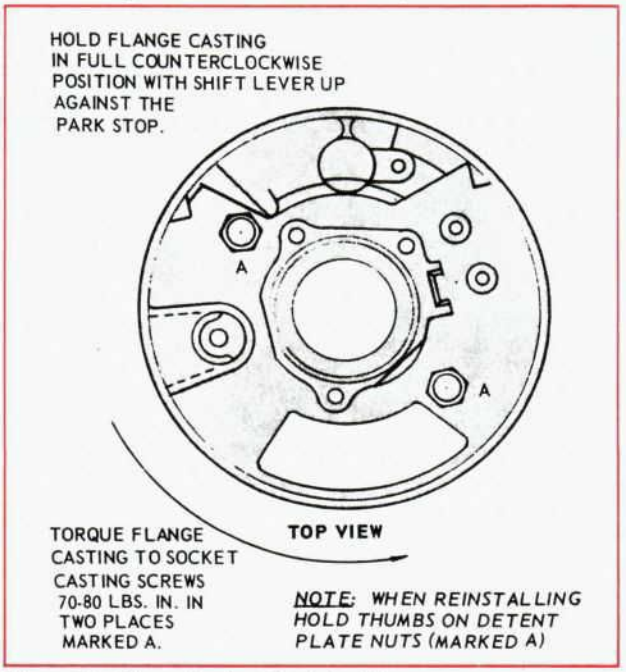


Figure 11—Flange Casting Retaining Nuts

7. Remove flange retaining nuts completely.
8. Remove snap ring (tru-arc) which retains flange to steering shaft and gently, but firmly, pull flange casting off the steering shaft.

   NOTE: Detent screw torque may be checked at this point—must be 13-17 inch pounds.
9. Remove the screw (1) that retains the socket casting to the shift tube. Remove socket casting, flange casting and turn signal switch/lever assembly from the vehicle to the bench.
10. At the bench, if the index plate is not tight when properly torqued, stake the index plate to flange casting at four (4) places indicated in Figure 12, with a center punch and hammer (or other suitable tool).

CAUTION: Do not hit the flange casting too hard during the staking process as damage to the casting may result.

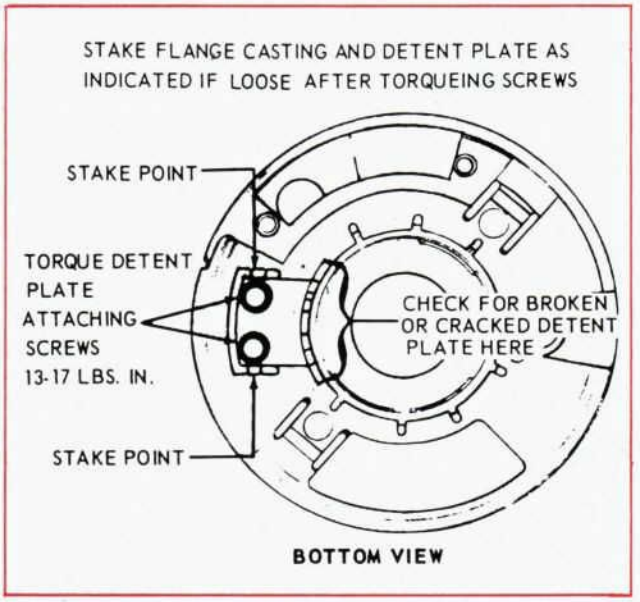


Figure 12—Flange Casting Detent Plate

INSTALLATION

1. Make sure that the turn signal switch connector is routed through the socket and flange castings and attach the socket casting to the column. Torque the screw 35-50 lbs. inch.
2. Insert the two (2) flange to socket casting retaining bolts through the holes in the insert plate and loosely attach them by turning the nuts on 2-3 threads.
3. Grasp the flange casting with both hands, fingers on the outside radius, and push the screws forward by placing the thumbs on the nuts.
4. With the screws held in this way, slide the flange casting onto the column assembly and with hard pressure firmly push the casting as far forward as possible.
5. Tighten the two screws and torque 70-80 lbs. inch.
6. Install the snap ring (tru-arc) using appropriate tru-arc pliers.
7. Pull the turn signal wires down through the socket casting, install the turn signal switch and lever, and re-install the steering wheel.

   NOTE: Apply 2-3 drops of Lock-tite and torque steering wheel retaining nut 30-40 lbs. ft.
8. Plug in electrical connector and reconnect battery.

STARTING MOTOR OVERHAUL

REPAIR OR REPLACE?

A faulty component just about always presents the automotive technician with the problem: repair or replace it? Parts do wear out, and when they do; of course, replace them. Replacing parts that can be repaired, however, can result in an unnecessary cost to your customers—a practice that builds neither confidence nor goodwill. You can avoid this pitfall by taking a little time to inspect each part before deciding how to correct the problem.

For instance, the following list illustrates three types of starting motor problems and the most common causes. Most can be repaired with a complete line of Autolite starting motor components available at Ford and Lincoln-Mercury dealers.

NO CRANK	SLOW CRANK	NOISY
1. Open field to terminal connection.	1. Loose pole (armature rub).	1. Loose pole (armature rub).
2. Loose pole (armature rub).	2. Foreign material between armature and pole (pole rub).	2. Foreign material between armature and pole.
3. Foreign material between armature and pole.	3. Worn Bearings (pole rub).	3. Damaged or worn starter drive.
4. Grounded or open armature.	4. Open field coil.	4. Damaged or worn ring gear.
5. Damaged or worn starter drive.	5. Grounded field coil.	5. Worn bearings (pole rub).
6. Shift mechanism worn or inoperative.	6. Shorted field coil.	6. Cracked/broken drive housing.
7. High mica on armature.	7. Grounded insulated brush holder and/or brush heads.	7. Cocked or misaligned on engine.
8. Glazed commutator.	8. Grounded armature.	
9. No point air gap.	9. Open armature.	
10. Grounded field circuit	10. Broken or weak brush springs.	
11. Cracked/broken drive housing.	11. Glazed commutator.	
	12. Cracked/broken drive housing.	

DISASSEMBLY AND INSPECTION

1. Check for clearance of cover band and plunger cover at starter field terminal. Check for clearance between plunger cover and movable pole and lever assembly. Check drive pinion for chipped or broken teeth and drive clutch drag condition. A drive with little drag, no drag or rough drag action is a probable slipping drive.

2. Remove cover band and plunger cover. Actuate plunger lever manually to check freedom of action. Examine switch connections to field and ground, switch contact gap while lever is seated on frame.

3. Examine brush leads for grounding to frame, brush holder or brush springs. Examine brush leads for rubbing against commutator. Using a small wire hook, remove brushes from holders.

4. Remove through bolts, examining each one for evidence of grounding to field coil connecting straps (burn spots on bolt).

5. Remove drive end housing, examine for physical damage such as cracks or fractures, excessive bearing wear or any bearing movement.

6. Remove brush end plate and check brush holders for tightness, insulators for cracks. Burn marks around brush holder rivets indicate a grounded brush holder.

7. Remove lever pin and lever. Check pin for pits or blackened condition which would indicate a lack of lubrication on the hinge and pin.

8. Remove armature and check for evidence of pole rub on the laminations, burned or pitted commutator resulting from short brushes or a burned spot which would indicate an open armature winding.

9. Remove drive assembly and check condition of shaft splines, drive flange and general condition.

10. Examine general conditions of frame assembly, brushes, brush leads, field coils and connecting straps for physical evidence of overheating, grounds, or shorts.

11. If the problem has not been located by this point, clean the components and conduct individual component testing as detailed below.

Cleaning

Use a brush or compressed air to clean the frame and field coils, armature and drive assembly. Clean the other components in solvent and wipe dry.

NOTE: DO NOT CLEAN DRIVE IN SOLVENT.

Drive Housing

Carefully inspect the drive housing (Fig. 1) for broken or cracked areas and for a damaged or corroded mounting surface. Inspect the drive housing bushing for excessive wear or scoring. Replace the drive housing assembly if damaged or the bushing is worn. Do not attempt to replace the drive housing bushing. On starters equipped with needle bearings in the drive housing, check the bearing for flat or missing needles. Replace the caged needle bearing assembly if worn or damaged.

STARTING MOTOR OVERHAUL

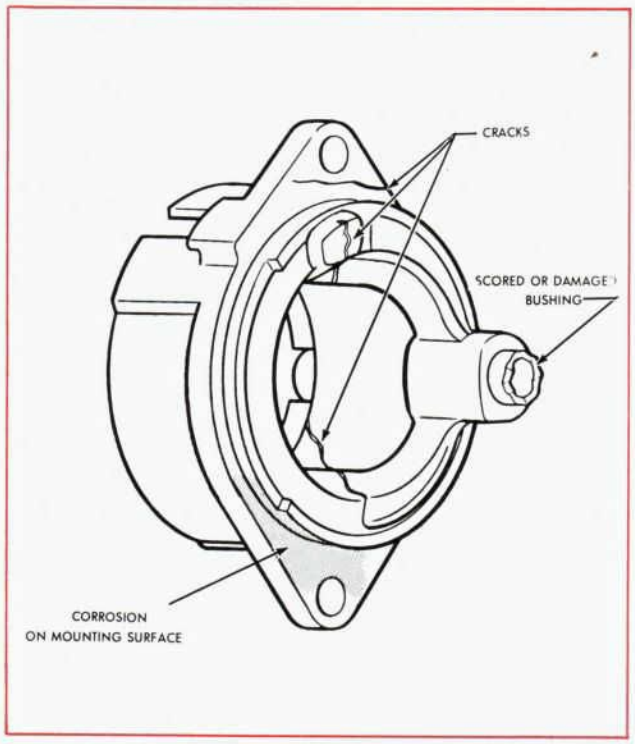


Figure 1—Drive Housing

TESTING

Brush Plate

Check the brush holders for broken springs and both insulated brush holders for shorts to ground.

1. Connect a jumper cable from the battery positive post to the brush end plate (Fig. 2).
2. Connect the negative lead of a voltmeter to the negative battery post.
3. Connect the positive lead of the voltmeter to the insulated brush holder.

If the voltmeter indicates any voltage the brush holder is grounded. Replace the brush plate assembly.

1. Check the brush end plate bushing for excessive wear.
2. Check the brush plate assembly for broken or cracked brush holder insulators.

Replace the brush plate assembly in case of broken or cracked brush holder insulators. Replace the brush plate bushing if excessively worn.

Armature

Examine the commutator for burned spots which usually indicate an open circuit. Such spots are caused by arcing each time a commutator segment that is connected to an open circuit winding passes beneath a brush. Carefully examine the armature for evidence of pole shoe rub. If the armature is scored or galled as shown in Fig. 3 it is usually the result of a loose pole shoe, worn bushing in the drive end housing or brush plate, or a cracked drive end housing.

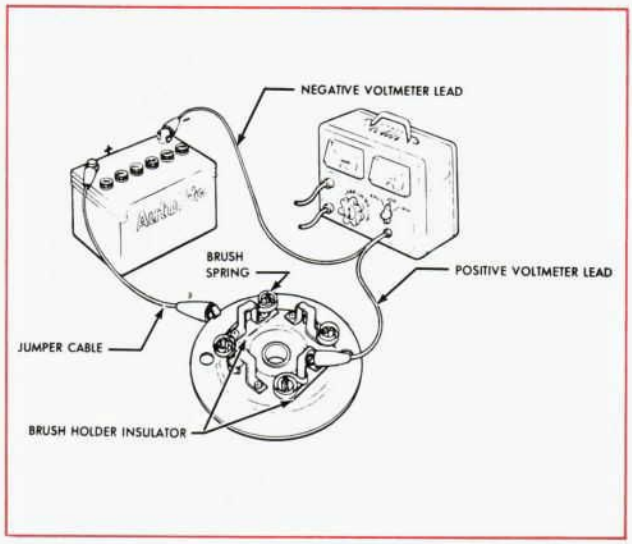


Figure 2—Brush Plate

If visual inspection of the armature indicates it is suitable for use, make an armature ground test (Fig. 4).

1. Connect a jumper wire from a 12-volt battery positive post to the drive end of the armature shaft.
2. Connect the voltmeter negative lead to the battery negative post and touch the voltmeter positive lead to the commutator.

If the voltmeter indicates any voltage, the armature windings are grounded and the armature must be replaced. Check the armature for a short circuit by placing it in a growler. Hold a thin steel blade (hack saw blade) parallel to the core and just above it while slowly rotating the armature in the growler, Fig. 5. A shorted armature will cause the blade to vibrate and be attracted to the core.

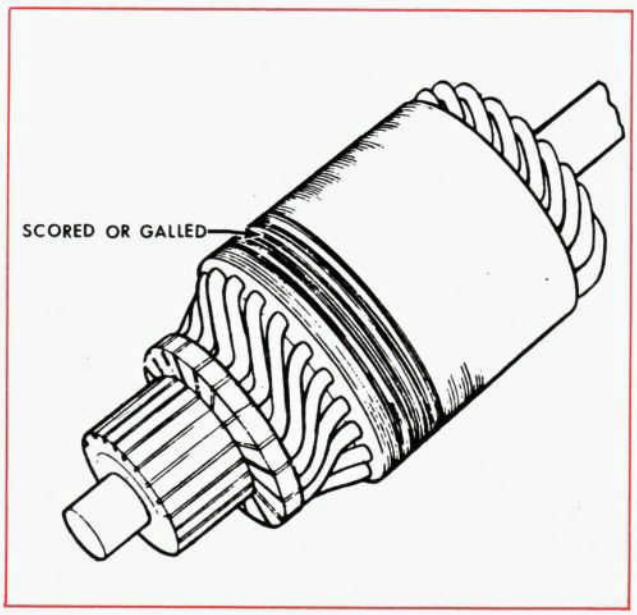


Figure 3—Armature Pole Rub

STARTING MOTOR OVERHAUL

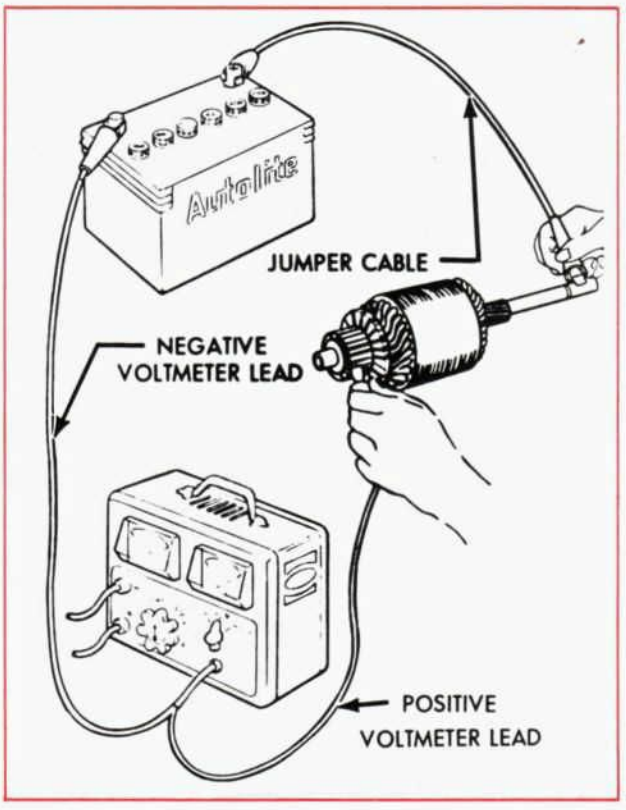


Figure 4—Armature Ground Test

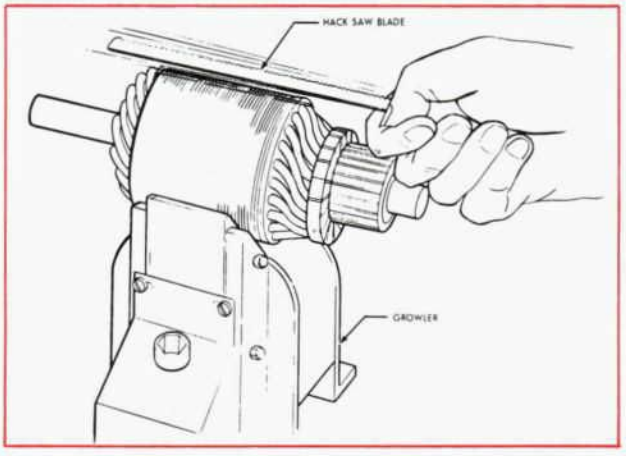


Figure 5—Armature Short Test

Field Coil—Open Circuit Test

1. Inspect all coil to coil connections, coil to switch connection and the coil to terminal connection for clean and tight solder joints or welds. Solder all loose connections using rosin core solder and a 300-watt iron.
2. Insulate the field coil and frame assembly from the work bench.
3. Turn the voltmeter range selector switch to the 4.0 volt position and turn the load control knob fully counterclockwise.
4. Connect a heavy jumper wire from the negative battery post to the two insulated brushes (Fig. 6).
5. Connect the negative lead of the voltmeter to the two insulated brushes and the positive lead of the voltmeter to the starter terminal.
6. Connect the negative lead of the ammeter to the starter terminal and the positive lead of the ammeter to the battery positive post. Be certain that all of the brush leads and tester leads are insulated from the starter frame.
7. Decrease the resistance by turning the load control knob clockwise until the voltmeter reads 0.5 volts. The ammeter should read 100 amps.

If the ammeter reading is 50 amps at 0.5 volts, one of the field coils or connections is open. Any deviation from the above readings resulting in higher ampere readings indicates a shorted or grounded field coil or connection. A lower ampere reading indicates a poor solder connection resulting in high resistance.

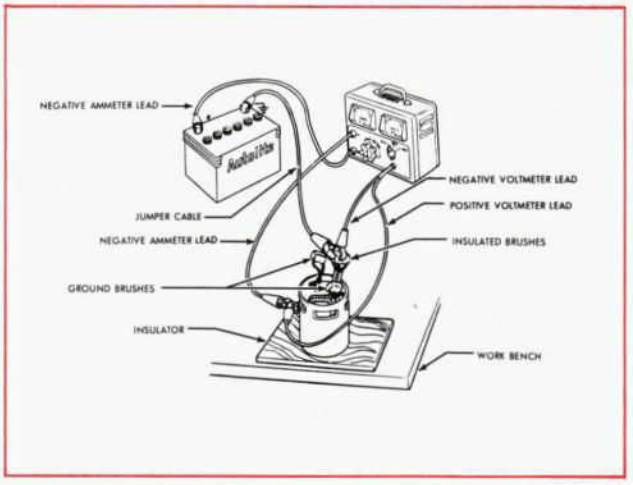


Figure 6—Field Coil Open Circuit Test

Field Coil—Grounded Circuit Test

To detect grounded field coils or connections proceed as follows:

1. Insert an insulator (business card or its equivalent) between the switch contacts (Fig. 7).
2. Disconnect the holding coil ground lead. Hold the field brushes and the holding coil ground lead away from starter frame.
3. Connect a jumper wire from the positive battery post to the starter frame.
4. Connect the positive voltmeter lead to the starter terminal and the negative voltmeter lead to the negative battery post.

If the voltmeter indicates any voltage, the field windings are grounded.

STARTING MOTOR OVERHAUL

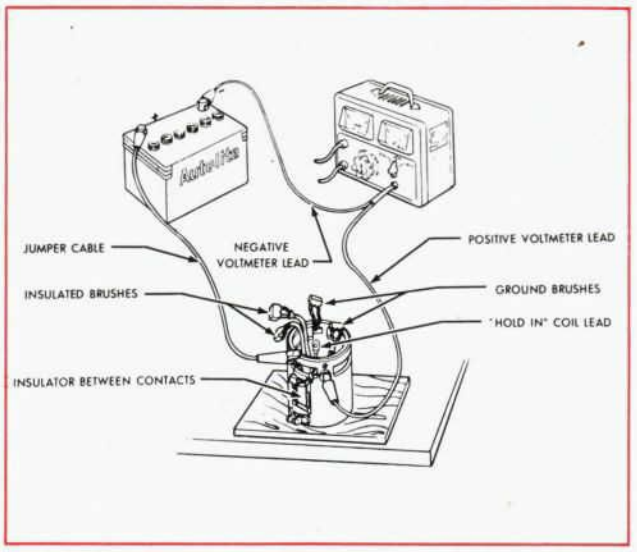


Figure 7—Field Coil Grounded Circuit Test

Terminal Stud

Check the terminal stud for crossed or stripped threads. Replace the terminal if it is broken, bent or if the threads are damaged.

Plunger

Thoroughly check the plunger lever assembly for the conditions shown in Figure 8. Replace any lever assembly which exhibits any of the above conditions.

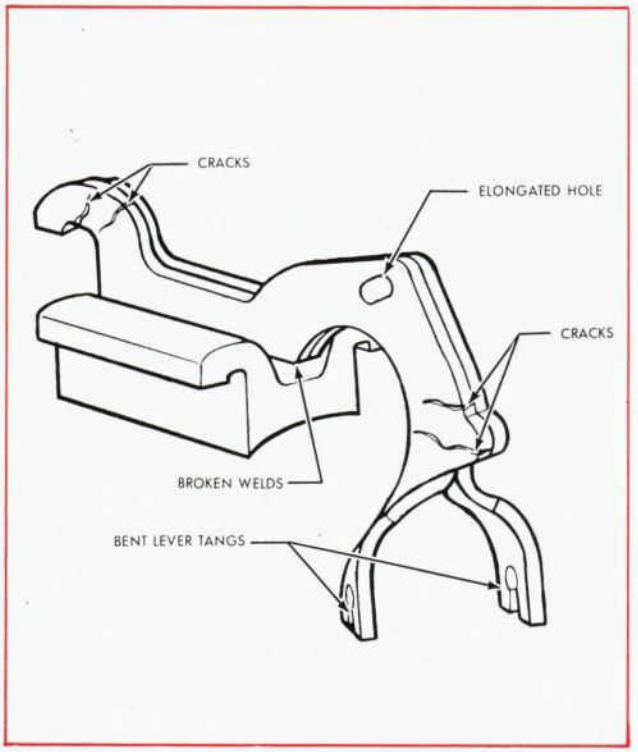


Figure 8—Plunger Defects

Brushes

Replace the starter brushes when they are worn down to ¼ inch. Check for broken or cracked brushes and burned or broken brush leads. When brush replacement is necessary, always install a complete set of brushes. Instructions for starter brush replacement are contained in the starter brush kit.

Switch Contacts

Be certain the switch contacts are properly aligned, have sufficient spring tension, and are clean. The contacts can be cleaned with a fine grade of sand paper. Instructions for switch contact replacement are contained in the switch kit.

Re-assembly

1. Install the starter terminal, insulator, washers, and retaining nut in the frame. Be sure to position the slot in the screw perpendicular to the frame end surface.
2. Position the coils and pole pieces, with the coil leads in the terminal screw slot, and then install the retaining screws (Fig. 9). As the pole shoe screws are tightened, strike the frame several sharp blows with a soft-faced hammer to seat and align the pole shoes, then tighten the screws securely.
3. Install the "hold-in" coil and retainer and bend the tabs to retain the coils to the frame.
4. Solder the field coil leads to the starter terminal using rosin core solder and a 300-watt iron. Solder the field coil lead to the stationary switch contact.
5. Check for continuity and grounds in the assembled coils.
6. Position the new insulated field brushes lead on the field coil terminal. Install the clip provided with the brushes to hold the brush lead to the terminals. Solder the lead, clip, and terminal together, using rosin core solder and a 300-watt iron.
7. Position the "hold-in" coil ground terminal over the nearest ground screw hole.
8. Position the ground brushes to the starter frame and install the retaining screws.
9. Apply a thin coating of Lubriplate 777 along the armature shaft splines. Install the starter motor drive gear assembly to the armature shaft and install a new stop ring. Install a new stop ring retainer.
10. Position the fiber thrust washer on the commutator end of the armature shaft and position the armature in the starter frame.
11. Lubricate brush end plate bearing with 777 Lubriplate, position the starter brush end plate to the frame with the end plate boss in the frame slot.
12. Position the starter drive lever assembly to the frame and starter drive assembly, be certain the lever is cor-

STARTING MOTOR OVERHAUL

rectly positioned over the starter drive flange, and install the pivot pin. Place a dab of Lubriplate 777 on pin.

13. Position the starter drive lever return spring and the drive end housing to the frame and install and tighten the through bolts to specifications (55-75 inch pounds). DO NOT PINCH THE BRUSH LEAD BETWEEN THE BRUSH PLATE AND THE FRAME. Be sure that the stop ring retainer is seated properly in the drive housing.
14. Install the brushes in the brush holders. BE SURE TO CENTER THE BRUSH SPRINGS ON THE BRUSHES AND DRESS THE BRUSH LEADS TO INSURE AGAINST GROUNDS AND SHORTS.
15. Check for switch contact alignment and clearance. (Fig. 10). Contact air gap with lever fully seated–should be .020 to .100.
16. Position the plunger cover and gasket on the starter and install the brush cover band. Tighten the band retaining screw.

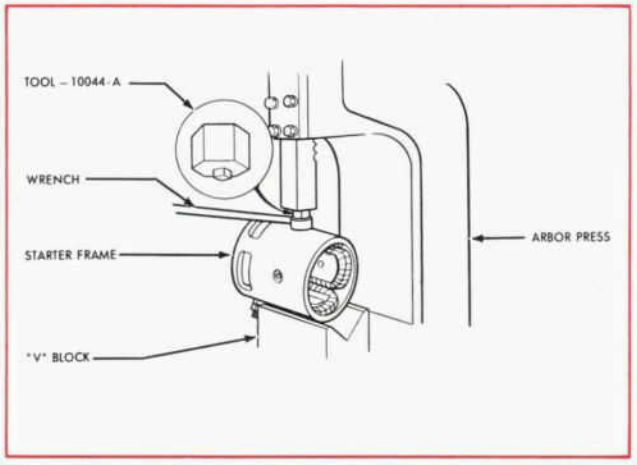


Figure 9–Field Coil Replacement

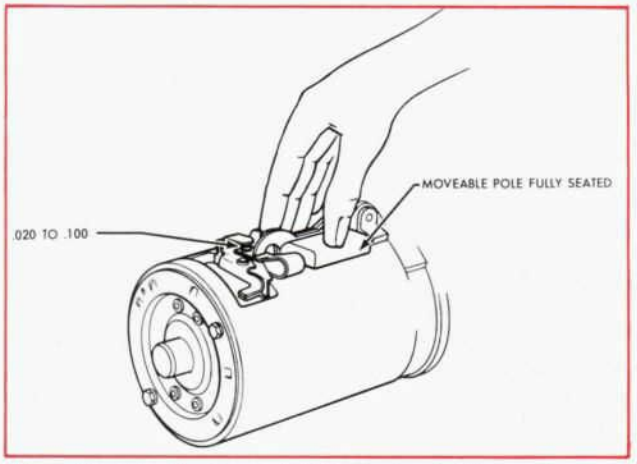


Figure 10–Checking For Switch Contact and Alignment

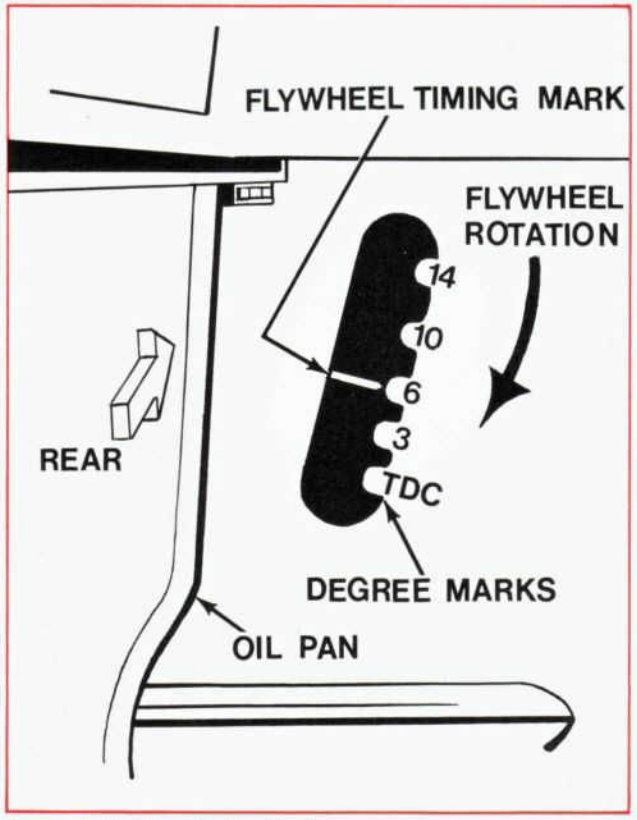


Figure 1–Ignition Timing Mark

ENGINE TIMING
(1969 Econoline with 240 CID Engines) & 1967 Econolines with 240 & 300 CID Engines

The timing mark on the subject Econoline engines is a line on the flywheel with standard transmission or a line on the flex plate an automatic transmission. The timing mark is viewed through an opening in the engine rear cover plate (Figure 1) on the lower left side of the engine. A rubber plug covers the opening to prevent the entrance of dust and dirt. Steel stamped degree marks ranging from 0° or top dead center (TDC) to 14°, before top dead center (BTDC) are located at the edge of the opening.

When checking the timing, the timing mark on the flywheel (or flex-plate) should be in line with the specified degree mark on the engine rear cover plate opening when the timing light flashes. Replace the rubber timing opening plug after timing engine.

RUST PROOFING OVERSPRAY ON DOOR LOCKS

Inoperative door locks, or latches that stick or operate sitffly, may be caused by rust proofing overspray. If the vehicle has been rust proofed, check for a coating of sticky, oily, black substance around the door locks. If contaminated by an overspray, remove the lock mechanism; and clean affected parts with solvent or Tar and Road Oil Remover. Lubricate with Ford Lock Lubricant B4A-19587-A, or equivalent, and re-install the lock mechanism.

NOTE: When applying rust proofing to vehicles, use great care to avoid direct spray on the locking mechanism.

FRONT WHEEL ALIGNMENT SPECIFICATIONS

• 1968 TRUCK • 1968 BRONCO • 1969 ECONOLINE

1968 TRUCK Front Wheel Alignment Specifications (Thru 7000 lb. axle cap.)

Vehicle Model	Front Axle Capacity	Alignment Factors	CHECKING SPECIFICATIONS Minimum	Maximum	Maximum Variation Between Wheels	Optimum Resetting Specifications Desired Alignment
F-100①	2600	Caster	+3¼°	+4¾°	1°	+4°
		Camber	+½°	+1½°	⅝°	+1°
F-250①	3000	Toe-in	1/16 inch	3/16 inch		⅛ inch
		King Pin Angle				4°
F-100① (4-Wheel Drive)	3000	Caster②	+2¾°	+4¼°	½°	3½°
		Camber②	1°	2°	½°	1½°
		Toe-in	1/16 inch	¼ inch		⅛ inch
		King Pin Angle				8½°
F-250 (4-Wheel Drive)	3000 3500	Caster	+3½°	+4½°	½°	+4°
		Camber	1°	2°	½°	1½°
		Toe-in	1/16 inch	¼ inch		⅛ inch
		King Pin Angle				7½°
F-350③	3800	Caster	+4¼°	+5¾°	1°	+5°
		Camber	0°	+1°	⅝°	+½°
		Toe-in	1/16 inch	3/16 inch		⅛ inch
		King Pin Angle				4°
P-100	2600	Caster	+3°	+4°	½°	+3½°
		Camber	+⅛°	+⅝°	¼°	+⅜°
		Toe-in	1/16 inch	3/16 inch		⅛ inch
		King Pin Angle				4⅝°
P-350 P-3500	3800	Caster	+3¾°	+5¼°	½°	+4½°
		Camber	+⅜°	+⅞°	¼°	+⅝°
		Toe-in	1/16 inch	3/16 inch		⅛ inch
		King Pin Angle				4½°
P-400 P-500 P-4000 P-500	3800 4700 3800 4700	Caster	+2¾°	+4¼°	½°	+3½"
		Camber	0°	+1°	½°	+½°
		Toe-in	1/16 inch	3/16 inch		⅛ inch
		King Pin Angle				4½°
F-N-B-500 thru 750 F-N-6000 7000-D	5000 5500	Manual				
		Caster	+3⅛"	+4⅛°	½°	+3⅝°
		Camber	+½°	+1½°	¼°	+1°
		Toe-in	1/16 inch	3/16 inch		⅛ inch
		Power				
		Caster	+6⅛°	+7⅛°	½°	+6⅝°
		King Pin Angle①				4°
F-N-B-6000 7000-D	6000 7000	Manual				
		Caster	+3½°	+4½°	½°	+4°
		Camber	+¾°	+1¼°		+1°
		Toe-in	1/16 inch	3/16 inch		⅛ inch
		Power				
		Caster	+6½°	+7½°	½°	+7°
		King Pin Angle				5½°
F-800 thru 950, C-550 thru 750, C-6000-7000, T-700-750, N-850-950, F-N-950-D	6000 7000	Caster	+2¾°	+3¾°	½°	+3¼°
		Camber	+½°	+1½°	¼°	+1°
		Toe-in	1/16 inch	3/16 inch		⅛ inch
		King Pin Angle				5½°

① Manual or Power Steering

The caster specifications shown are with the frame level from front to rear. Measure front to rear frame angle when checking alignment and compensate as follows. If the front of the frame is lower than the rear, the actual caster angle is obtained by adding the frame angle to the caster angle shown on the checking equipment. If the front of the frame is higher than the rear, subtract the frame angle from the caster angle shown on the checking equipment.

The following instructions are to be followed to assure a correct camber reading on F-100 thru 350 Twin I Beam Truck models

Install a spacer block between each frame side rail and its respective front axle I beam to obtain the height shown in views A and B. Raise the frame or add weight to the front of the vehicle to make the side rails rest on the blocks.
The radius of both front tires must be equal within ⅛ inch. Radius to be checked from center line of spindle to the ground.

② View B=3½ inches

③ View A=4 inches

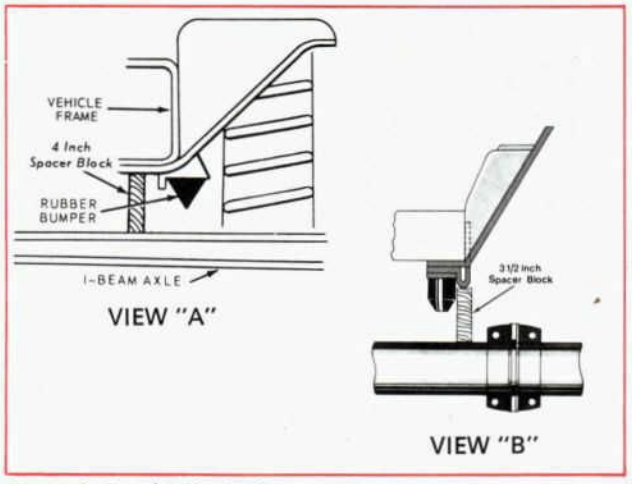


Figure 1—Truck Wheel Alignment Spacers

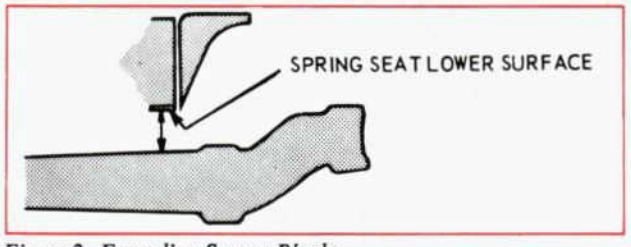


Figure 2—Econoline Spacer Blocks

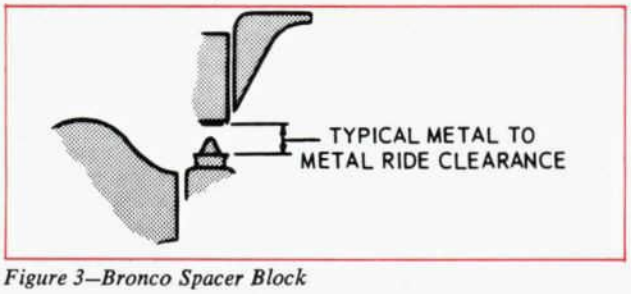


Figure 3—Bronco Spacer Block

TRUCK EQUIPMENT INSTALLATION

Equipment used for front wheel alignment inspection must be accurate. If portable equipment is used, perform all inspection operations on a level floor. In checking wheel alignment of F-100, F-250 and F-350 (4 x 2) trucks, place a 4-inch spacer block between both frame side rails and I-beams (Figure 1—View "A"). A 3½-inch spacer block is used on F-100 (4 x 4) trucks between the side rails and front wheel drive axle (View "B").

1. Drive the vehicle in a straight line to establish the straight-ahead position of the front wheels. Mark the steering column and steering hub with chalk to show the straight ahead position.

Do not adjust the steering wheel spoke position at this time.

If the front wheels are turned at any time during the inspection, align the chalk marks to bring the wheels back to the straight ahead position.

2. Install the wheel alignment equipment on the vehicle. Regardless of equipment used, be sure to follow the installation and inspection instructions provided by the equipment manufacturer.

ECONOLINE AND BRONCO EQUIPMENT INSTALLATION

The equipment installation information for the Econoline and Bronco models is the same as for the trucks, except for the size of the spacer blocks. In checking the wheel alignment of 1969 Econoline E-100 and E-200 models, use a 2.8-inch spacer block; and for E-300 models a 2.6-inch block (Figure 2). For 1968 Bronco models use a 3.5-inch block (Figure 3). This applies to both sides of the vehicle.

1969 ECONOLINE FRONT WHEEL ALIGNMENT SPECIFICATIONS

	Checking Specifications			Optimum Re-Setting Specifications
Wheel Alignment	Min.	Max.	Minimum Variation Between Wheels	Desired Alignment
Caster ③	+4°	+5½°	1°	+5°
Camber ③	+0°	+1°	⅝°	+½°
Toe-in (inch)	1/16 in.	3/16 in.	—	⅛ in.

1968 BRONCO FRONT WHEEL ALIGNMENT SPECIFICATIONS

	Checking Specifications			Optimum Re-Setting Specifications
Wheel Alignment ①	Min.	Max.	Maximum Variation Between Wheels	Desired Alignment
Caster ① ③	+2¾°	+4¼°	+½°	+3½°
Camber ① ③	+1°	+2°	+½°	+1½°
Toe-in (inch)	1/16	¼		⅛
GENERAL SPECIFICATIONS				
Wheel Base				92 inches
Thread				57½ inches •
① Not adjustable	• With 3300 lb. Axle 56¾ inches			

The caster specifications shown are with the frame level from front to rear. Measure front to rear frame angle when checking alignment and compensate as follows. If the front of the frame is lower than the rear, the actual caster angle is obtained by adding the frame angle to the caster angle shown on the checking equipment. If the front of the frame is higher than the rear, subtract the frame angle from the caster angle shown on the checking equipment.

The following instructions are to be followed to assure a correct camber reading.

Install a spacer block between each frame side rail and its respective front axle I beam to obtain the height shown in Fig. 2. and 3. Raise the frame or add weight to the front of the vehicle to make the side rails rest on the blocks.

The radius of both front tires must be equal within ⅛ inch. Radius to be checked from center line of spindle to the ground.

② With blocks installed as shown in Fig. 2.

③ With blocks installed as shown in Fig. 3.

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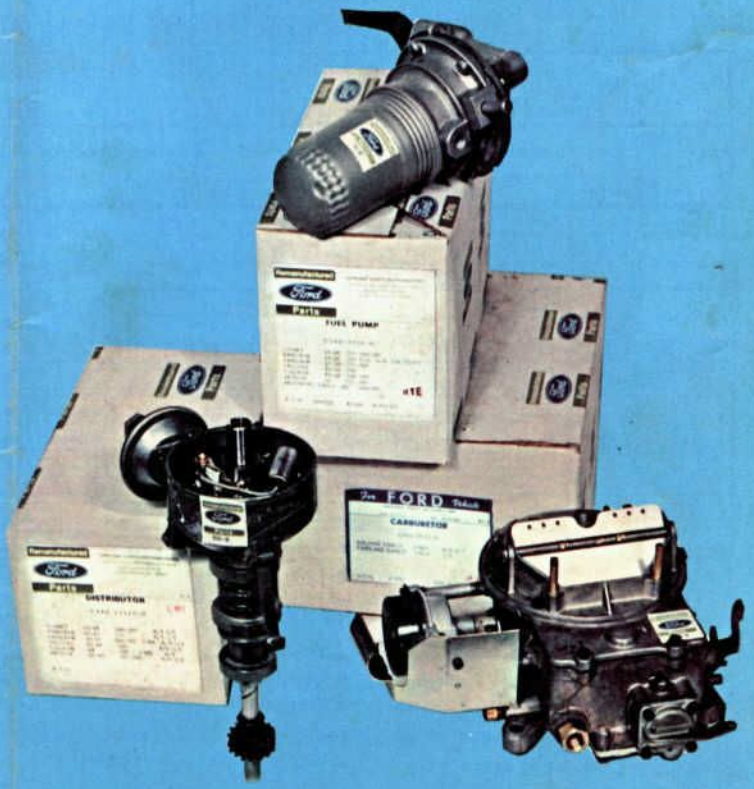

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