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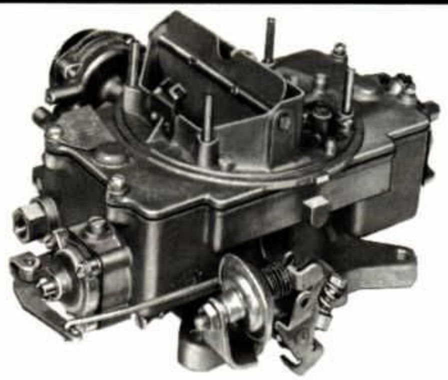
Shop Tips FROM FORD

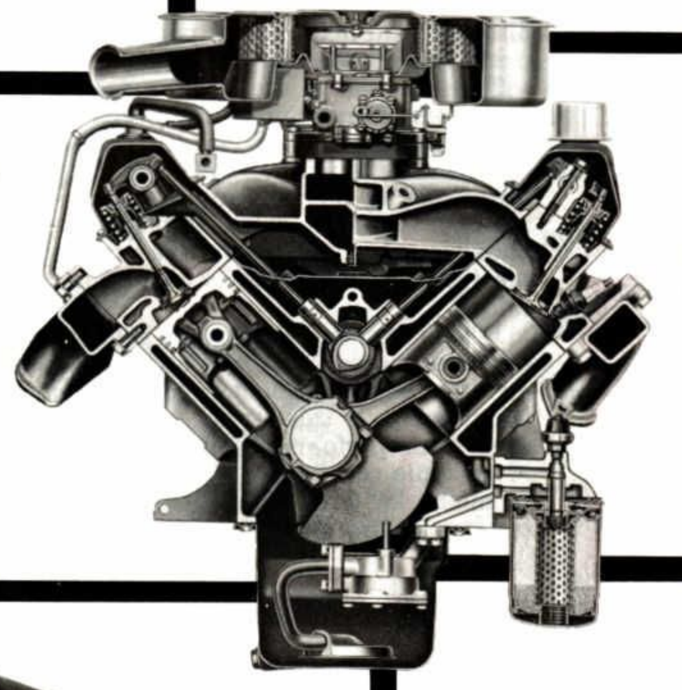
VOL. 4, NO. 2

Technical parts and service information published by Ford Division to assist servicemen in Service Stations, Independent Garages and Fleets.



IGNITION AND FUEL SYSTEMS
Diagnosis and Testing

See Index Page 2 For Other Timely Articles



From Your Ford Dealer

Be sure to 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: Ford Division of Ford Motor Company, Parts and Service Promotion and Training Dept., P. O. Box 598, Dearborn, Michigan 48121.

FoMoCo GENUINE PARTS

ROTUNDA

INTRODUCTION

This is the second in a series of articles presented to help service personnel quickly trouble-shoot engine problems by using a systematic diagnosis procedure. Last month, the Battery, Charging and Starting Systems, which usually cause "no-cranking" or "slow-cranking" problems, were covered. If the engine cranks normally, but fails to start, chances are the ignition or fuel system is at fault. The ignition system will be covered first, then the fuel system.

IGNITION SYSTEM

Generally, two main types of ignition problems are encountered. One, is poor performance. This usually indicates a major tune-up is required, using a scope or similar detailed testing equipment. (This will be covered in the next issue of Shop Tips). At this time, only quick tests that indicate defects or deficiencies which might cause the second type of ignition problem hard-starting, will be covered. In some cases the quick tests will also find and help correct poor performance problems, but they are not primarily intended for this pupose.

The function of the ignition system is to ignite the combustible air-fuel mixture under pressure in each cylinder at just the right moment to produce the most efficient engine operation. Under normal operating conditions, the ignition system must perform its job about 10,000 times every mile; by forcing a surge of electricity to jump a spark plug gap. This requires 15,000 to 20,000 volts. Considering that the source of electrical power is only 12 volts, and the exacting timing requirements, its easy to see that all specifications and adjustments must be accurately maintained.

FORD ignition systems are precision engineered to give long trouble-free operation. However, a certain amount of wear is unavoidable; so to maintain engine efficiency and performance at high levels, periodic service is necessary. If this service is ignored, or low quality replacement parts used, then performance and/or starting problems are likely to develop. Much time can be saved when trouble-shooting starting problems, and "come backs" avoided, if the following information is used, together with the step by step diagnosis procedures.

COMPONENTS (Conventional System)

The major components of the conventional ignition system are: the battery, ignition switch, ignition coil, distributor, spark plugs and wiring. They are arranged in a low voltage and a high voltage circuit; and connected together by the ignition coil.

The low voltage or PRIMARY CIRCUIT consists of:

- Battery
- Ignition Switch
- Primary circuit resistance wire
- Breaker Points (Distributor)
- Condenser (Distributor)
- Primary windings of the ignition coil

The high voltage or SECONDARY CIRCUIT consists of:

- Secondary windings in the ignition coil
- Rotor (Distributor)
- Distributor cap
- High Tension (Voltage) wires
- Spark Plugs

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Diagnosis and Testing

OPERATION

Primary Circuit—The primary circuit is "hot" or in operation only when the breaker points are closed. Low (12) volt current is supplied by the battery and/or generator-alternator, and flows through the ignition switch to the primary windings of the coil; then, to ground through the closed breaker points. Figure 1. As long as current is flowing steadily in the primary circuit, the secondary circuit is inactive. However, since the current must ultimately jump an air gap at the spark plug, which works like putting a gigantic resistance in the circuit, (especially with high compression engines), the low 12 volt input voltage must be stepped up a thousand or more times. This is done with a coil.

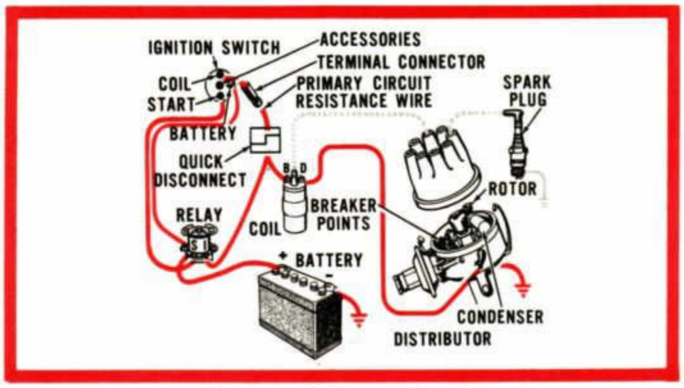


Figure 1—Primary Circuit

Ignition Coil—The ignition coil produces high voltage electricity, non-mechanically. It consists of *primary windings* (a few hundred turns of heavy wire wound around a soft iron core), and *secondary windings* (several thousand turns of fine copper wire wound over the primary windings). When current flows through the primary circuit, a magnetic field is developed in the coil. When the breaker points open, the primary circuit is broken and the magnetic field collapses around the secondary windings of the coil,producing high voltage current.

Secondary Circuit—During the time the breaker points are open, the primary circuit becomes inactive, and the secondary circuit becomes "hot". Figure 2. High voltage current (5,000 to 20,000 volts depending on engine

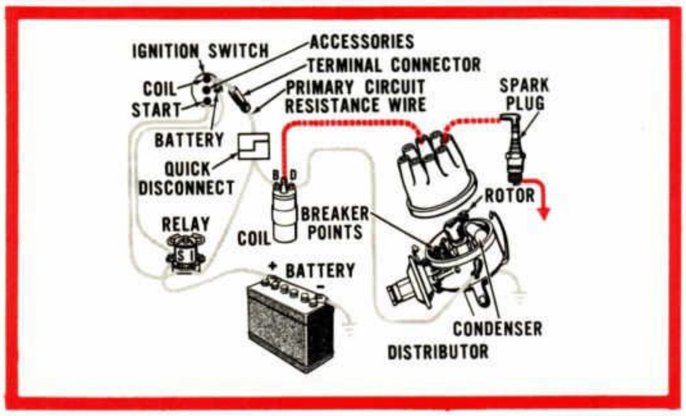


Figure 2—Secondary Circuit

requirements) flows out of the center terminal of the coil to the center terminal of the distributor cap, down through the rotor and back out the distributor cap through the high tension wiring to the spark plug. The high voltage current jumps the spark plug gap to ground, creating a spark which ignites the compressed air-fuel mixture in the cylinder.

Condenser—*The condenser is connected across the* breaker points in the primary circuit, and performs two jobs. When the breaker points open and the primary circuit is broken, the current wants to continue flowing and jump across the point gap. The condenser, however, momentarily provides a place for the current to flow, thus controlling arcing and point burn. This also has the effect of quickly stopping the flow of current, which increases the amount of high voltage output in the coil.

Distributor—Distributor components not only carry both low and high voltage current, but they also mechanically time the spark plugs to fire at the right moment. The distributor shaft is geared to the camshaft which rotates at one-half crankshaft speed. A cam is attached to the upper end of the shaft. Figure 3.

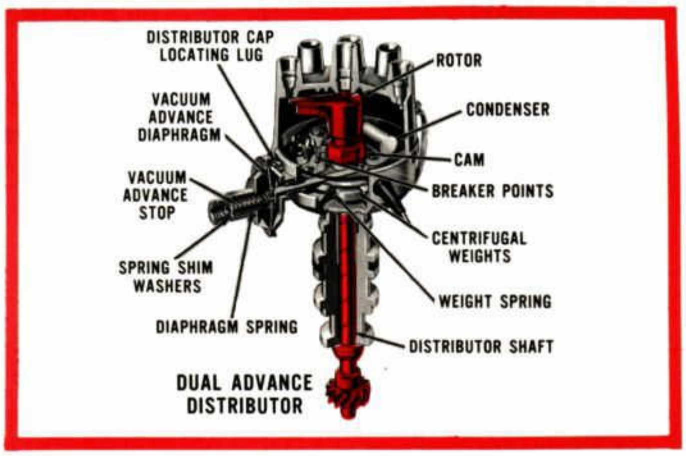


Figure 3—Distributor Components

The cam has as many lobes as there are cylinders, and it opens and closes the breaker points. The rotor is attached and indexed to the distributor shaft. The distributor cap is indexed to the distributor housing. When the housing is correctly positioned in the engine block, the rotor is always aligned with one of the terminals of the distributor cap when the breaker points open. Thus, for each two revolutions of the crankshaft, the distributor shaft makes one complete revolution, firing each spark plug once in the proper order.

DIAGNOSIS AND TESTING

When the engine cranks normally, but fails to start, and the fuel system is O.K. (See page 8), the trouble, most likely, is a weak or no spark. Since the ignition system is divided into a primary low voltage circuit and a high voltage secondary circuit, connected by the coil, the coil is a convenient place to start isolating the trouble.

NOTE: Before checking the ignition system, the battery should be visually inspected, and a capacity test performed to insure the battery is in good condition. (See January 1966 Shop Tips). The ignition system will not perform properly, especially during cold weather, if the battery is run down or defective. REMEMBER, the coil amplifies battery voltage a thousand times or more. A two or three volt drop at the battery, or elsewhere in the primary circuit, can mean up to a 5,000 volt drop at the spark plug.

Test Procedure

1. Remove the coil high tension lead from the center of the distributor cap. Figure 3.
2. Hold the high tension lead approximately $^{3}/_{16}$ inch from the cylinder head.
3. With the ignition switch on, crank the engine and check for a spark.

If the spark is good, the trouble lies in the secondary circuit. If there is no spark or a weak spark, the trouble is in the primary circuit, coil to distributor high tension lead, or the coil. (See Test Chart)

TEST CHART

Check for spark from coil high tension lead	
SPARK Possible Problems	**NO SPARK (or weak spark)** Possible Problems
1. Fouled or improperly adjusted spark plugs.	1. Defective primary wiring, or loose or corroded terminals.
2. Defective high tension wiring.	2. Burned, shorted, sticking or improperly adjusted breaker points.
3. High tension voltage leak across the coil, distributor cap or rotor.	3. Defective condenser.
	4. Defective coil.

PRIMARY CIRCUIT TESTS

A complete test of the primary circuit consists of checking resistance in the circuit from the battery to the coil, the circuit from the coil to ground, and the starting ignition circuit. A voltmeter is used in each test to check voltage drop (resistance).

Battery to Coil Test

1. Connect the voltmeter leads as shown in Figure 4.
2. Install a jumper wire from the distributor terminal of the coil to a good ground on the distributor housing.
3. Turn the lights and all accessories off.
4. Turn the ignition switch on.
5. If the voltmeter reading is 6.9 volts or less, the primary circuit from the battery to the coil is O.K.
6. If the voltmeter reading is greater than 6.9 volts, check the following:

a) The battery and cables for loose connections or corrosion.
b) The primary wiring for worn insulation, broken strands, and loose or corroded terminals.
c) The resistance wire for defects.
d) The starter relay to ignition switch for defects.

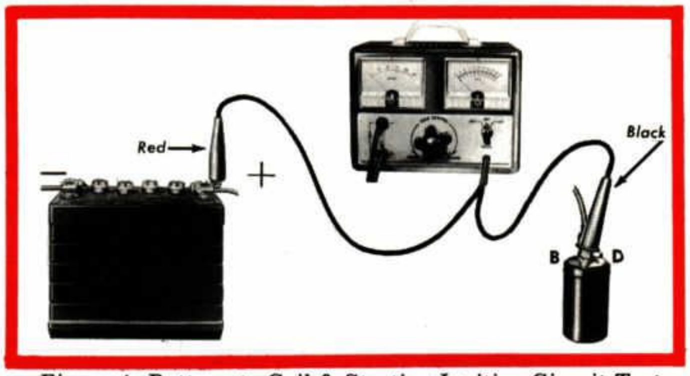


Figure 4—Battery to Coil & Starting Ignition Circuit Test

Starting Ingition Circuit Test

1. Connect the voltmeter leads as shown in Figure 4.
2. Disconnect and ground the coil to distributor high tension lead at the distributor.
3. With the ignition switch off, crank the engine by installing a jumper wire between the battery and the "S" terminal of the starter relay, while observing the voltage drop.
4. If the voltage drop is 0.1 volt or less, the starting ignition circuit is O.K.
5. If the voltage drop is greater than 0.1 volt, clean and tighten the terminals in the circuit or replace the wiring as necessary.

Ignition Switch Test

1. Connect the voltmeter leads as shown in Figure 5.
2. Install a jumper wire from the distributor terminal of the coil to a good ground on the distributor body.
3. Turn off all of the accessories and lights.
4. Turn the ignition switch on.
5. If the voltmeter reading is 0.3 volt or less, the ignition switch and the relay to switch wire are O.K.
6. If the voltmeter reading is greater than 0.3 volt, either the ignition switch and/or the wire are defective.

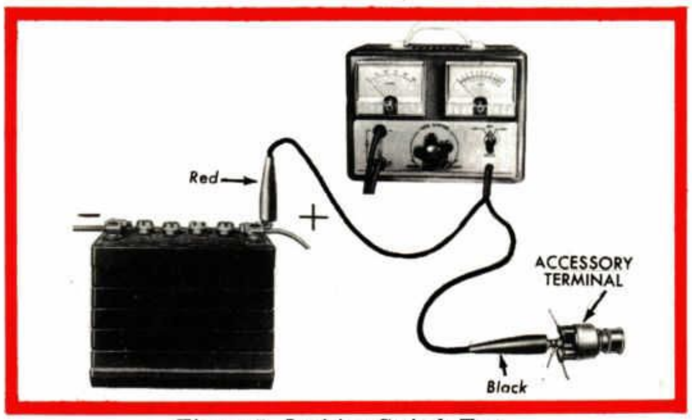


Figure 5—Ignition Switch Test

Resistance Wire Test

1. Connect the voltmeter leads as shown in Figure 6.
2. Install a jumper wire from the distributor terminal of the coil to a good ground on the distributor housing.

3. Turn off all the accessories and lights.
4. Turn the ignition switch on.
5. If the voltmeter reading is 6.6 volts or less, the resistance wire is O.K.
6. If the voltmeter reading is greater than 6.6 volts, replace the resistance wire.

Figure 6–Resistance Wire Test

Coil to Ground Test

1. Connect the voltmeter leads as shown in Figure 7.
2. Close the breaker points.
3. Turn all the accessories and lights off.
4. Turn the ignition switch on.
5. If the voltmeter reading is 0.1 volt or less, the primary circuit from coil to ground is O.K.
6. If the voltmeter reading is greater than 0.1 volt, test the voltage drop between each of the following:
   a) The coil and the breaker point terminals of the coil to distributor primary wire.
   b) The movable breaker point and the breaker plate.
   c) The breaker plate and the distributor housing.
   d) The distributor housing and engine ground.

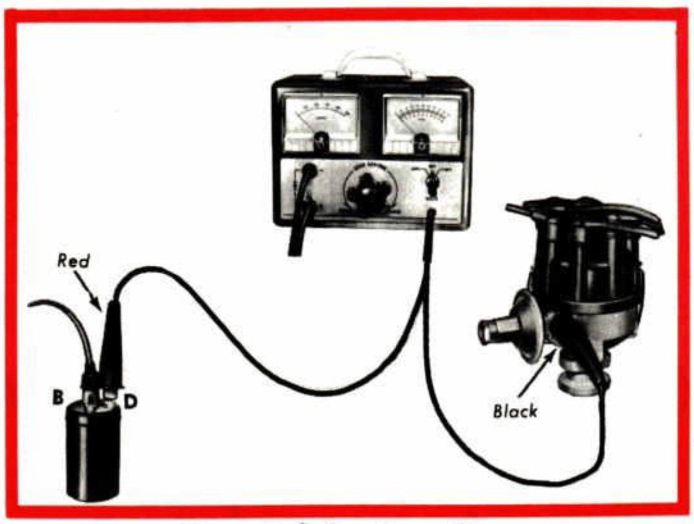


Figure 7–Coil to Ground Test

Breaker Points–In addition to the above resistance test, the breaker points should also be visually inspected for burning, pitting, or metal transfer than can cause hard starting. Also check for correct alignment as shown in Figure 9 under Service Tips. Check the gap by turning or "bumping" the engine with the ignition starter switch, until the rubbing block is on the high point of a cam lobe. Insert a flat feeler gauge to measure gap. NOTE: Use of a flat feeler gauge to gap *used* breaker points is only an approximate measurement. Only a scope or dwell meter can accurately check the gap of used breaker points.

Condenser–Generally, condensers either work or don't work. If the original spark was weak and the breaker points are pitted, check the condenser with a reliable condenser tester for leakage, capacity and resistance.

Coil–The ignition coil is subject to road grime and splash, especially salt which is a good conductor of electricity. Excessive dirt may cause the coil to short out in cold, wet weather. Clean the coil with a rag dipped in solvent and wipe dry. Check for carbon tracks and cracks. Be sure all terminals are clean and tight and correct polarity is observed (On negative ground electrical system, the distributor primary lead should be connected to the negative (−) ignition coil terminal). Again check for spark at the distributor end of high tension wire. If still no spark or weak, check the coil on a reliable coil tester. Be sure and follow the manufacturer's instructions.

SECONDARY CIRCUIT TESTS

Electricity is always trying to find the path of least resistance. All the problems of leakage, excessive resistance, shorts and grounds in the low voltage primary circuit are magnified many times in the high voltage secondary circuit. With upwards of 20,000 volts looking for an "easy path" or leak to ground, wet and cold weather hard starting is most often caused by a problem in the secondary circuit. Secondary circuit tests consist mainly of checking possible points where dirt or moisture have not been sealed out, and the high voltage is allowed an easy path to ground, rather than be forced to jump across the spark plug gap.

Test Procedure

Check the spark intensity of one spark plug wire at a time as follows:

1. Disconnect a spark plug wire and install a terminal adapter.
2. Hold the wire with a pair of insulated pliers, so the adapter is approximately $3/16$ inch from the exhaust manifold and crank the engine. The spark should jump the gap regularly and be of uniform intensity.

3. If the spark intensity of all the wires is satisfactory, the coil, condenser, rotor, distributor cap and the secondary wires are probably O.K. The problem is in the spark plugs.
4. If the spark is good at only some wires, check the resistance of faulty leads.
5. If the spark is equal at all wires, but weak or intermittent, check the coil, distributor cap, distributor rotor and the coil to distributor high tension lead.

Ignition Coil (See Primary Circuit Tests)

Distributor Cap—Clean the distributor cap with a soft bristle brush and clean water. Rinse thoroughly and dry with compressed air. Be careful not to scratch or wipe with oily shop rags, as this can lead to carbon tracking. Inspect the cap for cracks, burned contacts, permanent carbon tracking, dirt or corrosion in the sockets.

Rotor—Clean the rotor with a soft bristle brush and clean water. Rinse thoroughly and dry with compressed air. Check the rotor for cracks and the blade for excessive burning. Never file the edge of the blade as this increases the air gap between the rotor and distributor tower inserts and causes excessive arcing and wear.

Secondary Wiring (High Tension)—Wipe the wires with a damp cloth and check for fraying, breaks, or cracked insulation. Inspect the terminals and weather seals for looseness or corrosion.

Spark Plugs—Examine the firing ends of spark plugs, noting the type of deposits and the degree of electrode erosion. See Service Tips, Page 7 for the various types of spark plug fouling and their causes. Clean the plugs on a sand blast cleaner and examine for cracked or broken insulators, badly pitted electrodes, and other signs of failure.

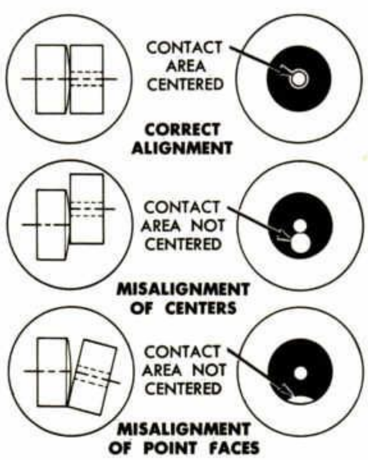


Figure 8—Breaker Point Alignment

CONDITION	CAUSED BY
 BURNED	Any discoloration other than a frosted slate grey shall be considered as burned points.
 EXCESSIVE METAL TRANSFER OR PITTING	Incorrect alignment. Incorrect voltage regulator setting. Radio condenser installed to the distributor side of the coil. Ignition condenser of improper capacity. Extended operation of the engine at speeds other than normal.

Figure 9—Breaker Point Inspection

SERVICE TIPS

Breaker Points—The unique Ford vent-hole distributor points are used on all models. The "hole in the middle" design lets air through the contacts for cooler operation and retards deposit formation. However, to take full advantage of the vented-type design, the points must be accurately aligned. Any misalignment will cause premature wear, overheating and pitting. Turn the cam so the breaker points are closed and compare with Figures 8 & 9.

Align the breaker points to make full face contact by bending the stationary breaker point bracket. DO NOT BEND THE MOVABLE BREAKER ARM.

After the breaker points have been properly aligned, adjust the breaker point gap or dwell. A scope, dwell meter, or a flat feeler gauge can be used to check NEW breaker points. Only a scope or a dwell meter can be used to check USED breaker points. It is not advisable to use a feeler gauge, due to the roughness of used points. If the breaker points are badly burned or pitted, they of course should be replaced as shown in the chart on Page 7.

Wiring—A visual inspection of ignition wiring and connections is an important part of trouble shooting the ignition system. However, the following precautions must be adhered to:

• Automotive ignition systems produce high frequency signals that can interfere with radio reception. Practically all Ford secondary ignition wiring incorporates a linen or rayon core impregnated with carbon to form a resistance or suppression to this undesirable interference. However, some performance engines use a solid steel core to obtain a hotter spark. Solid steel core wires do not afford any resistance or suppression to radio interference. A Radio Interference Suppression Kit should be used with this type of wiring as shown in the chart. Never intermix the two types (steel core and resistance core) of wires on the same vehicle.

WIRING CHART

Part Number	Name	Application
A9AZ-12259-C	Steel Core Wire	6 Cylinder
C4AZ-18827-B	Suppression Kit	6 Cylinder
A9AZ-12259-D	Steel Core Wire	8 Cylinder
C4AZ-18827-A	Suppression Kit	8 Cylinder

• When removing wires from spark plugs, coil or distributor tower always break the seal between the boot and plug or tower by first gently twisting the boot. Then, pull straight up with a steady force. Never attempt to loosen the wire by pulling or jerking on the cable, as this may damage the terminal or core.

• To reinstall the wire, push the terminal firmly in place, then, slide the boot or nipple in place. Be sure the seal is secure and free of dirt.

• Always use adapters between the spark plug and terminals to connect test equipment leads. Never pierce or puncture the wiring with any type of probe as this will destroy insulation and possibly damage the core or protective boot.

Spark Plugs—All Ford models are equipped with Autolite spark plugs which incorporate an extra-long firing tip (a design which maintains heat retention within a stable range) to help promote self cleaning. The self cleaning power tip keeps gas mileage and engine performance at peak levels. Spark plugs must also operate within certain temperature ranges to obtain maximum plug life and engine performance. A wide variety of plugs of suitable heat ranges for a given engine and operating conditions are available. They are listed by number, with a higher number denoting a hotter plug, much like a thermometer. Generally, cold plugs are used in engines that operate at high temperatures, such as sustained high speeds; and hot plugs are used in engines that operate at cooler temperatures such as continued low speeds. If the spark plugs are causing starting problems, check the following chart for causes of the spark plug trouble. Figure 10.

Ignition Timing—Improper ignition timing by itself seldom can cause hard starting. However, it should be checked after performing any ignition system work. This is especially true if the breaker points are replaced. Be sure and check the latest specifications.

CARBON FOULED

IDENTIFIED BY BLACK, DRY FLUFFY CARBON DEPOSITS ON INSULATOR TIPS, EXPOSED SHELL SURFACES AND ELECTRODES.
CAUSED BY TOO COLD A PLUG, WEAK IGNITION, DIRTY AIR CLEANER, DEFECTIVE FUEL PUMP, TOO RICH A FUEL MIXTURE, IMPROPERLY OPERATING HEAT RISER OR EXCESSIVE IDLING. CAN BE CLEANED.

OIL FOULED

IDENTIFIED BY WET, BLACK DEPOSITS ON THE INSULATOR, SHELL BORE AND ELECTRODES.
CAUSED BY EXCESSIVE OIL ENTERING COMBUSTION CHAMBER THROUGH WORN RINGS AND PISTONS, EXCESSIVE CLEARANCE BETWEEN VALVE GUIDES AND STEMS, OR WORN OR LOOSE BEARINGS. CAN BE CLEANED.

GAP BRIDGED

IDENTIFIED BY DEPOSIT BUILD-UP CLOSING GAP BETWEEN ELECTRODES.
CAUSED BY OIL OR CARBON FOULING. IF DEPOSITS ARE NOT EXCESSIVE, THE PLUG CAN BE CLEANED.

LEAD FOULED

IDENTIFIED BY DARK GRAY, BLACK, YELLOW OR TAN DEPOSITS OR A FUSED GLAZED COATING ON THE INSULATOR TIP.
CAUSED BY HIGHLY LEADED GASOLINE. CAN BE CLEANED.

NORMAL

IDENTIFIED BY LIGHT TAN OR GRAY DEPOSITS ON THE FIRING TIP.
CAN BE CLEANED.

WORN

IDENTIFIED BY SEVERELY ERODED OR WORN ELECTRODES.
CAUSED BY NORMAL WEAR. SHOULD BE REPLACED.

FUSED SPOT DEPOSIT

IDENTIFIED BY MELTED OR SPOTTY DEPOSITS RESEMBLING BUBBLES OR BLISTERS.
CAUSED BY SUDDEN ACCELERATION. CAN BE CLEANED.

OVERHEATING

IDENTIFIED BY A WHITE OR OR LIGHT GRAY INSULATOR WITH SMALL BLACK OR GRAY BROWN SPOTS AND WITH BLUISH-BURNT APPEARANCE OF ELECTRODES.
CAUSED BY ENGINE OVERHEATING, WRONG TYPE OF FUEL, LOOSE SPARK PLUGS, TOO HOT A PLUG, LOW FUEL PUMP PRESSURE OR INCORRECT IGNITION TIMING.

PRE-IGNITION

IDENTIFIED BY MELTED ELECTRODES AND POSSIBLY BLISTERED INSULATOR. METALLIC DEPOSITS ON INSULATOR INDICATE ENGINE DAMAGE.
CAUSED BY WRONG TYPE OF FUEL, INCORRECT IGNITION TIMING OR ADVANCE, TOO HOT A PLUG, BURNT VALVES OR ENGINE OVERHEATING. REPLACE THE PLUG.

Figure 10—Spark Plug Inspection

FUEL SYSTEM

INTRODUCTION

If the engine cranks normally, but fails to start, and the ignition system is O.K., the trouble is probably in the fuel system, Figure 11. The fuel system has the relatively simple, yet delicate job of pumping gas to the carburetor, mixing the gas with air, and delivering it to the intake manifold for distribution to each cylinder.

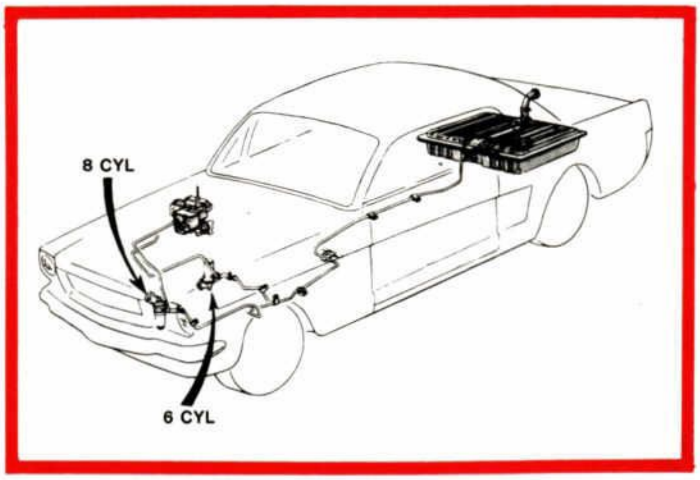


Figure 11–Fuel System

Fuel system hard starting problems usually are: no air fuel mixture is getting to the cylinders, or its either too lean or too rich. Possible causes are:

- **Plugged air or fuel filter.**
- **Defective fuel pump.**
- **Automatic choke malfunction.**
- **Sticking or incorrectly seating needle and seat.**
- **Incorrect fuel float level.**
- **Improperly vented gas tank.**
- **Idle Mixture.**
- **Idle speed adjustment.**
- **Driver flooding engine through improper starting technique.**

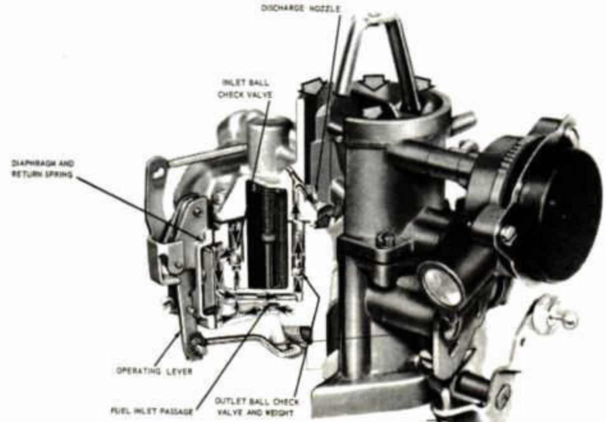


Figure 12–Carburetor Discharge Nozzle

DIAGNOSIS AND TESTING

There's no hard and fast rule as to where to start looking for fuel system hard starting problems. However, a couple of obvious things should be checked. First, be sure there is gas in the tank; and second, that the driver is not flooding the carburetor by excessively pumping the accelerator during starting. Then, remove the air cleaner and check the filter element for excessive dirt which could limit air flow to the point where the engine won't start. Next, with the air cleaner removed, pump the accelerator rod a couple of times and observe whether or not gas squirts from the discharge nozzles in the carburetor, Figure 12.

If gas squirts from the nozzles, the fuel filter, fuel pump, connecting lines and fuel tank are O.K. It can be assumed the trouble is with the automatic choke, idle mixture, linkage adjustment, or somewhere within the carburetor such as the needle and seat or the float level.

No Gas at the Discharge Nozzle Tests

This indicates no gas is getting to the carburetor.

1. Check for a clogged or restricted fuel filter. Some are located between the fuel pump and carburetor, (Figure 13) and some are part of the fuel pump, (Figure 14). To check in-line filters, disconnect the fuel inlet line from the fuel pump side of the filter. Crank the engine (with the coil to distributor wire removed) and note if any gas is ejected from the fuel line. CAUTION: IF THE ENGINE BLOCK IS HOT, USE A CONTAINER TO CATCH THE GAS TO AVOID A POSSIBLE FIRE. If gas is ejected, the filter is at fault and should be replaced. To check filters that are part of the fuel pump, replace with a known good filter.

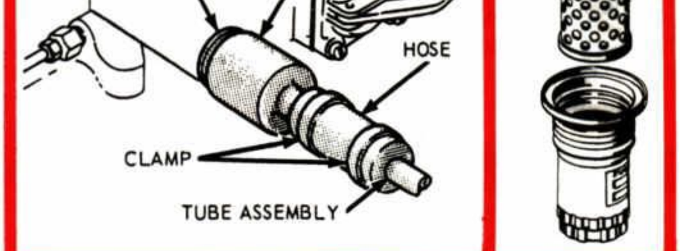


Figure 13–In-Line Fuel Filters

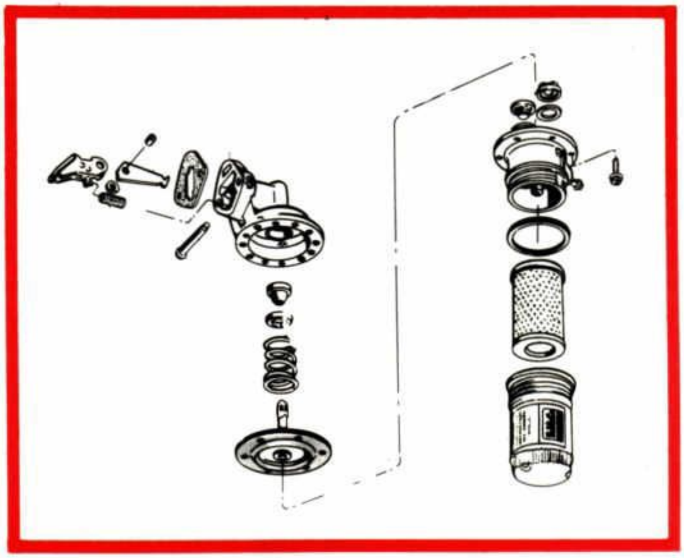


Figure 14—Integral Fuel Filter

2. If no gas is ejected in test (1), check the fuel pump for Pressure and Capacity.

• Connect a pressure gauge, petcock and flexible hose, (Figure 15) between the carburetor inlet connector and the fuel inlet line connector.

• Position the flexible hose in the restrictor so that the fuel can be expelled into a suitable container for the capacity (volume) test.

• Operate the engine. Vent the system into the container by opening the hose restrictor momentarily before taking a pressure reading.

• Operate the engine at 500 rpm. The pressure should stabilize between 4.0-6.0 psi for 6 cylinder engines and the 289 V-8, and 4.5-6.5 psi for the larger V-8 engines.

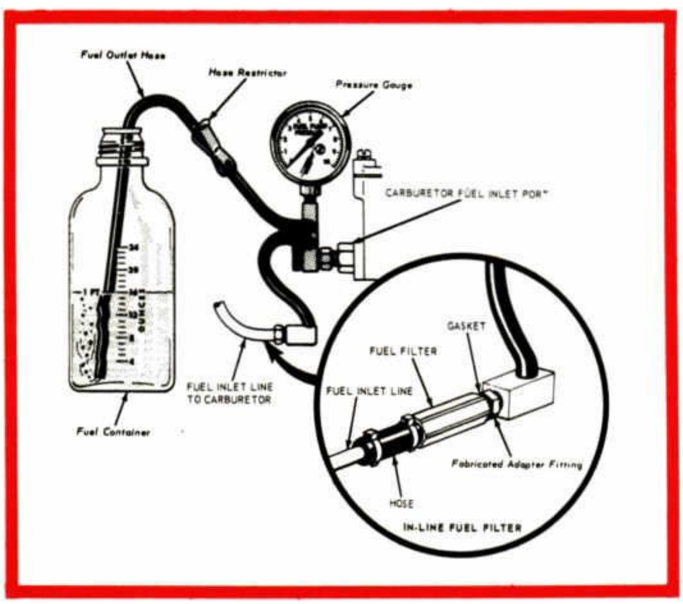


Figure 15—Fuel Pump Tests

• Perform a capacity test only if the pressure test is within specifications. Operate the engine at 500 rpm and open the restrictor and observe the time required to expel *one pint* of fuel into the container. It should take about 30 seconds for the 6 cylinder engines, and about 20 seconds for V-8 engines.

3. If the fuel pump capacity (volume) is low but the pressure is normal, it indicates a restriction in the fuel lines or gas tank such as dirt, water, ice, kink, clogged gas tank filter, etc. It also may indicate an obstruction to the fuel tank vent, which may collapse the tank or fuel lines.

NOTE: All fuel tanks are vented to atmospheric pressure, either through the gas cap or an external tube. Vented caps are so marked. If a non-vented cap is used where a vented cap is required, fuel will not flow and the tank may collapse. Dirt can plug the vent tube and cause the same problems.

Gas at the Discharge Nozzle

If gas is getting to the carburetor, but the engine is hard to start, it indicates a problem associated with the carburetor. Since there are several types of carburetors, and many adjustments and specifications for each depending upon usage; only approximate adjustments and specifications that could cause a starting problem will be covered. These adjustments and specifications should not be used except as a quick check for starting problems. If they are used as final adjustments, gas mileage, performance, engine surging, etc. will be affected.

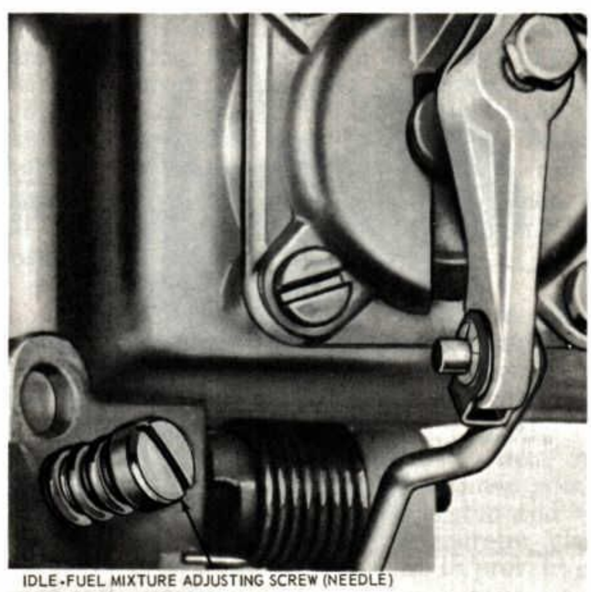


Figure 16—Idle Mixture Screw

IDLE FUEL MIXTURE AND IDLE SPEED—The idle fuel system of the carburetor is in operation during cranking and choking, so it must be correctly adjusted to avoid hard starting. The idle mixture screw(s), Figure 16 should be turned out (counterclockwise) about one and a half turns from the fully seated position. NOTE: IF THE SCREW NEEDLE HAS BEEN TIGHTLY SEATED, THE END MAY BE GROOVED. IF SO, THE NEEDLE MUST BE REPLACED BEFORE A SATISFACTORY FUEL MIXTURE CAN BE OBTAINED.

The 1½ turn adjustment is approximate as a slightly different adjustment may be necessary to obtain a smooth running engine. Fast idle (cold engine) specifications are approximately 1500 rpm. Hot engine specifications are approximately 575 rpm, and should be checked before the fast idle (cold engine) speed.

The idle adjusting screw contacts the lower edge of the fast idle cam, Figure 21. With the choke plate open, and the throttle plate seated in the throttle bore, the adjusting screw should be about one turn past just contacting the cam. As the choke plate opens, it rotates the fast idle cam and results in a slower idle rpm as the engine temperature rises and choking is reduced.

CHOKE SYSTEM—The choke system is designed to enrich the air-fuel mixture during the engine warm up period. It consists of a manual or thermostatically controlled choke plate in the top of the carburetor, which when closed causes fuel to flow from the main fuel system as well as the idle speed system, greatly enriching the air-fuel mixture.

Manual Choke should be checked for correct operation from the open to the closed position. If stuck open or closed, inspect linkage for causes such as binding, etc. To avoid over choking and flooding, the choke plate should not touch the bore wall, but have a clearance of approximately 0.230 inch, in the closed position.

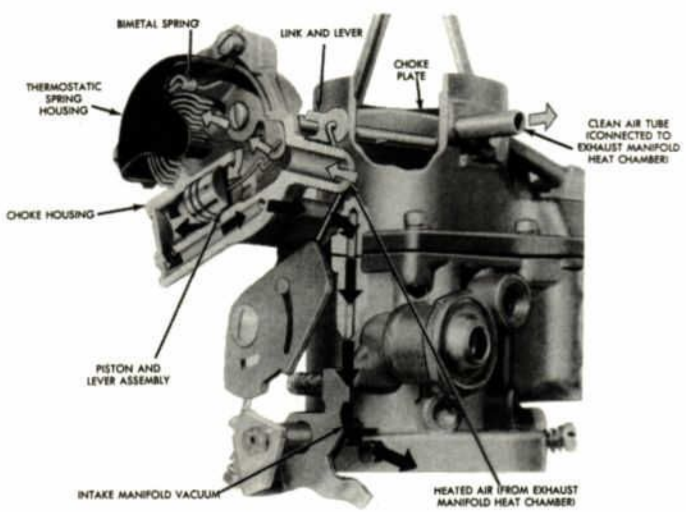


Figure 17—Automatic Choke System

Automatic Chokes should also be checked for proper operation from the open to the closed position. It functions much like a manual choke, except that a bi-metal thermostatic spring controls choking by winding up when cold and unwinding when warm. Figure 17. When the throttle is depressed as the engine is started, the linkage should allow the bi-metal spring to wind up and close the choke plate. Engine vacuum acts on the piston, which pulls against the thermostatic spring to partially open the choke to prevent stalling. A stuck piston can cause a hard starting problem. As the engine warms up, the spring expands, opening the choke plate to the vertical or open position. When properly adjusted, the choke plate should have a clearance between the body bore of approximately 0.160 inch. Figures 18-19.

If the choke bottoms on the body wall or is stuck closed, the carburetor will become flooded. To start

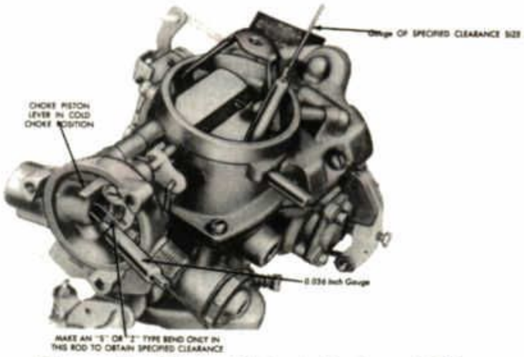


Figure 18—Choke Plate Adjustment 1V

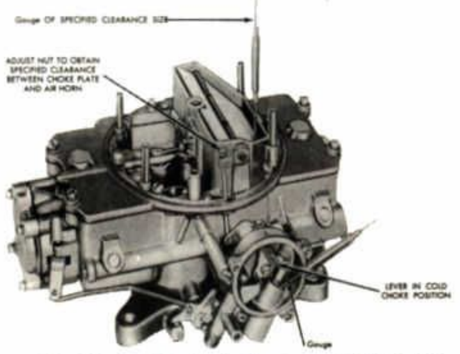


Figure 19—Choke Plate Adjustment 2V & 4V

the vehicle, push the accelerator all the way to the floor and hold it there while the engine is cranked. The carburetor linkage is designed so the choke plate should partially open, thereby "unloading" the carburetor or decreasing the richness of the air-fuel mixture to allow starting.

Thermostatic Spring Housing Adjustment controls the amount of heat required to open and close the choke plate. Turning the housing in a counterclockwise direction will require a higher temperature (cold weather operation) to fully open the choke plate. Turning the housing in a clockwise direction will cause the plate to be fully open at a lower temperature. This is in the lean direction as indicated by the arrows. About one (1) mark rich is the normal setting, Figure 20.

Figure 20—Thermostatic Spring Housing Adjustment

FAST IDLE CAM—The fast idle cam works in conjunction with the choke during the warm up period to provide a fast idle and prevent stalling. With the thermostatic spring housing rotated 90 degrees past the index, the throttle plate closed, and the adjustment screw aligned with the index mark on fast idle cam, Figure 21, the choke plate should have a clearance between the body bore of about 0.020 inch (#76 drill).

NEEDLE AND SEAT AND FLOAT LEVEL—Fuel must be maintained at the correct level in the fuel bowl to prevent flooding or too lean or too rich an air-fuel mixture. If the float leaks, or sets too far down in the fuel bowl, the needle and seat will be closed and no fuel will be metered into the venturi. If the float sets too high, the needle and seat will meter too much fuel and flood the engine. This is usually evident by fuel seeping out of the carburetor and an excessive odor of gas. Check proper float level specifications before bending float arm.

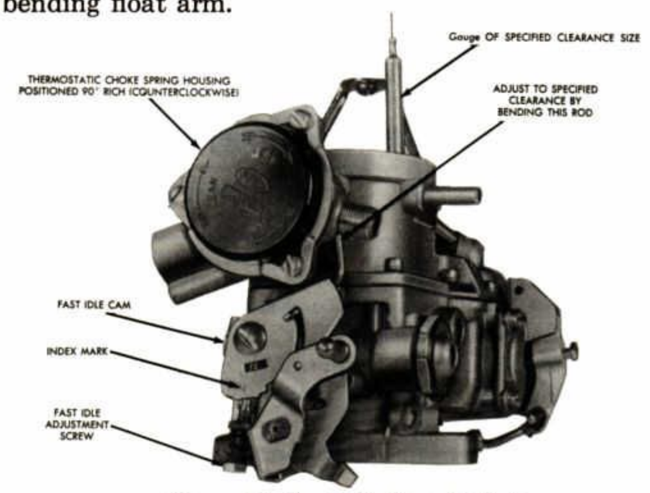


Figure 21—Fast Idle Cam Linkage

SERVICE TIPS

FUEL FILTERS—*Fuel Tank Filters* normally do not require servicing. However, water and dirt in the gas tank may necessitate cleaning the gas tank and in some cases replacing the filter. This is usually evidenced by a repeatedly plugged fuel line filter.

Fuel Line Filters for all engines except the 427 CID need only be replaced as required. The filter for the 427 engine should be replaced every 36,000 miles. Never attempt to clean a fuel line filter. If it doesn't filter properly, replace it. Excessive sediment in the fuel bowl of the carburetor is a sign of insufficient filtering.

AIR FILTERS—*Dry Type Paper* filter elements should be inspected by holding them up to a light and looking for splits, cracks, pin holes or distortions; any of which require the element be replaced. The recommended replacement interval is 36,000 miles. Paper elements should never be cleaned with a flammable solvent or cleaning solution. Neither should oil be added to the surfaces of the filter element or air cleaner body. Dry Type paper elements should be cleaned every 6,000 miles by one of the following methods:

1. Direct a stream of compressed air through the element, opposite to the flow of intake air (that is, blow air from the inside outward). Hold the nozzle at least 5-6 inches from the element, and do not use air pressure in excess of 100 psi.
2. Hold the element vertically and gently tap against a smooth horizontal surface until all dirt and dust is removed.
3. Wash the filter element in a warm (105°) solution of low sudsing detergent and water. (About one cup of detergent for every five gallons of water.) Immerse the element in the solution, moving it up and down in a swishing manner so as to force the solution through the pleated paper. Continue washing action for three to five minutes.

If dirt or contaminants are stubbornly ingrained or caked to the element, soak the element in the solution for fifteen minutes and repeat the washing action. Discard the cleaning solution, and rinse the element thoroughly, using the same swishing motion as in cleaning. A thorough rinsing is most important to assure that all foreign material is completely removed.

Remove excess water by hand, shaking the element with a whipping action. Allow the element to air dry before reinstalling (especially in the winter to prevent freezing). A fan or air draft may be used to hasten drying, but DO NOT HEAT THE ELEMENT in any way. Do not use compressed air to hasten drying because a wet element can easily be ruptured.

Polyurethane filter elements can not be cleaned. They must be replaced. The recommended periodic replacement interval is 12,000 miles.

CARBURETOR REPAIR—*Gaskets* removed to make an adjustment or repair to a carburetor should always be replaced with "new" gaskets when assembling the carburetor. "Used" gaskets can lead to "come backs" and similar complaints.

Linkage should not be indiscriminately bent or adjusted to get the car started. Oftentimes gum and varnish may cause sticking. Choke piston and shafts can be cleaned with a reliable carburetor cleaner. Some of the bends in the linkage are to prevent interference and give exact adjustment to carburetor operation. Always check the latest specifications, available in many publications, before altering the linkage.

WIND NOISE DIAGNOSING

Longer periods of high speed driving on limited access highways and improvements made in the engine, muffler tuning, vehicle sound packages and road surfaces, have made wind noise characteristics more audible to the vehicle passengers. The average owner is not knowledgeable about the development problems encountered when attempting to reduce wind noise, however, he does know and expects his car to provide him with the maximum personal comfort under all operating conditions.

To meet his requirement, new methods and procedures have been developed to assist service personnel in diagnosing wind noise problems. These procedures will enable them to accurately locate the problem area in a minimum amount of time. However, the success achieved in correcting wind noise problems will be entirely dependent upon accurate diagnosis. The new method of diagnosis involves the use of an automotive stethoscope. The stethoscope transmits the wind noise sound to the diagnostician's ears. This method has proved to be most successful in isolating the problem area. When using the stethoscope, the metal sound rod should be removed from the end of the plastic hose. (See Figure 1.) While an assistant is driving the vehicle the plastic hose end of the stethoscope should then be moved along the sealing surface of the suspected problem area to isolate the exact problem area.

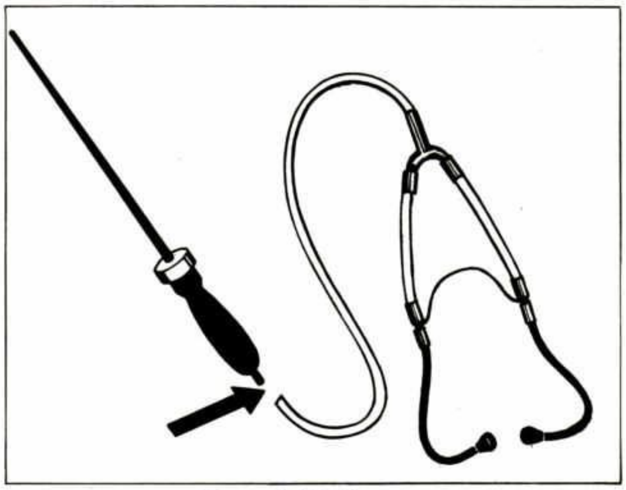


Figure 1—Stethoscope

The most common causes of objectional wind noise are:

- Seal leaks
- Sealer omission in body flanges
- Unsealed tooling holes
- Misfitted panels and mouldings
- Maladjusted doors and windows

LAYMAN'S DESCRIPTION	GENERAL DESCRIPTION	CAUSE
Tea Kettle Whistle	Very high pitch	Air forced through small orifice
Hiss	Sharp sibilant sound	Air rushing through gap or hole
Pop Bottle	Medium pitch whistle	Air rushing over gap or hole
Burble	Low pitch flutter	Air breaking up as it passes up and over unsealed openings
Swish	Brushing prolonged sound	Air hitting external protuberances

PROCEDURE

The most common types of wind noise and their general description and causes are listed in the table below.

When conducting a vehicle test, drive at speeds between 60 and 70 m.p.h. (when permissible). The vehicle should be driven in two directions to compensate for the prevailing winds. The road traffic should be moderate with a minimum of heavy trucks and the road surface should be smooth and dry to minimize road noise.

An investigation has shown that the areas shown in Figure 2 influence the vehicle interior noise level. To locate the possible problem area, the locations shown in the chart (Figure 2) should be checked with the stethoscope starting at the following points.

AREA 1—Start at the top of the vent window and move the plastic hose end of the stethoscope along the front door glass to roof rail seal moving rearward to the top of the center pillar.

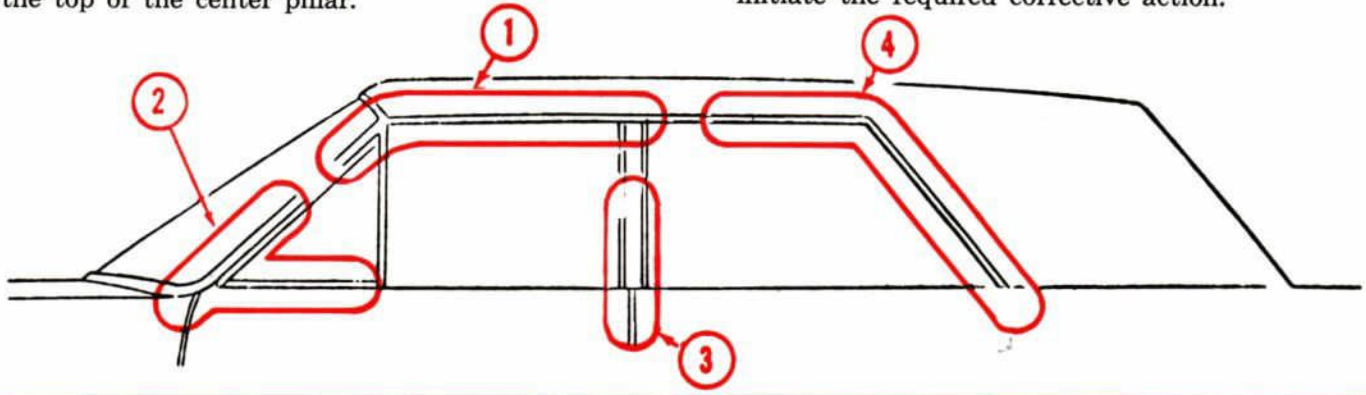
AREA 2—Start at the vent window lower corner at the belt and move the stethoscope hose rearward to the division bar, then check the vent to "A" pillar seal area.

AREA 3—Start at the top of the center or quarter pillar and check the seal to approximately six inches below the belt.

AREA 4—Start at the rearward edge of the rear door at the belt and move upward to the roof rail.

NOTE: On hardtop models, check the roof rail retainer to roof rail seal by placing the end of the stethoscope hose between the roof rail and retainer and moving it along the entire surface.

The point where the maximum amplitude is encountered, indicates the exact problem area. When the problem area and cause or causes have been located, initiate the required corrective action.



AREA 1 LOCATIONS	AREA 2 LOCATIONS	AREA 3 LOCATIONS
Center Pillar w/Strip Overleaf To Roof Rail w/Strip	Vent Window Nose Area	Center Pillar w/Strip
Roof Drip Moulding	Vent Window Pivots	Rear of Front Door Belt Front of Rear Door Belt
Div. Bar Door Glass Rubber Stop	Vent Frame to Rubber	Upper Corners of Door Glass to w/Strip or Runs
Vent Window w/Strip Upper Corner	Vent Window w/Strip Lower Rear Corner	**AREA 4 LOCATIONS**
CONV. ONLY: Top w/Strip Seal to Header Moulding	"A" Pillar w/Strip to Door	
CONV. ONLY: Windshield Header Moulding to Body Struct.	Door w/Strip to Hinge Pillar at Belt	
CONV. ONLY: "A" Pillar w/Strip and Roof Rail w/Strip Junct.	Door Outer Panel to Vent Casting at Belt	Roof Rail w/Strip or Retainer at Rear Belt
CONV. ONLY: Top Material to Roof Side Rail	Door Inner Panel to Vent Casting at Belt	Rear Door w/Strip at Belt

Figure 2—Wind Noise Problem Areas

POOR FUEL ECONOMY AND/OR ROUGH IDLE

(All Vehicles Equipped with 1V Carburetor)

Poor fuel economy and/or rough idle may be encountered if the vent valve is maladjusted. The adjustment should be checked after the carburetor has been properly adjusted for "hot" idle rpm. At this point, the index mark on the vent valve rod should be *even* with the open end of the vent valve rod hole, as shown in the Figure 1.

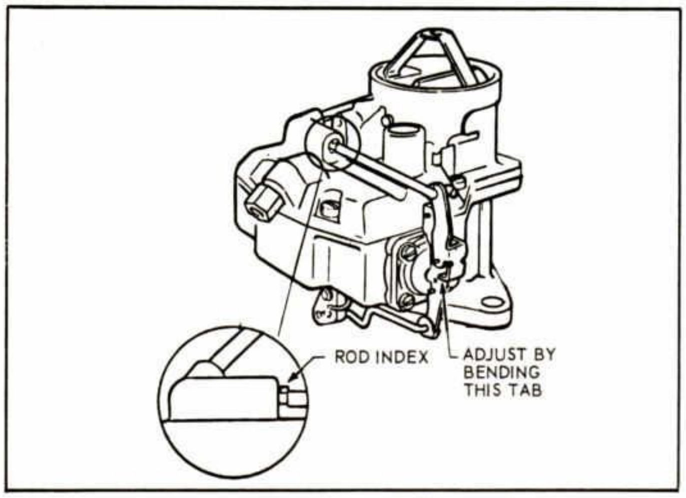


Figure 1—Vent Valve Adjustment

COLD ENGINE STALL ON AUTOMATIC TRANSMISSION ENGAGEMENT

(1966 Ford, Fairlane and Thunderbird Equipped with 390, 410, 428 C.I.D. Engines and 4V Carburetor)

To correct harsh transmission engagement and prolonged automatic choke operation, the subject vehicles have reduced fast idle speed and faster choke come-off times. Cold engine stalls upon transmission engagement can be corrected by performing the following inspection and adjustments.

1. The choke pulldown rod may be binding in the airhorn due to the felt and brass washers not sliding in the retainer. Spread the retaining clip slightly to provide a free sliding motion.
2. Reset the thermostatic choke cap by an additional two marks in the rich direction. (Making a total of three marks in the rich direction).
3. Check the engine fast idle speed (engine must be at normal operating temperatures). Adjust the fast idle speed if necessary to 1300 rpm for standard engines and 1500 rpm for thermactor engines, with the fast idle adjusting screw on the kickdown step of the fast idle cam.
4. Adjust the curb idle speed to specifications (475-500 rpm in drive) standard engine (525-550 rpm in drive) Thermactor engine.

ELECTRICAL FEEDBACK DURING EMERGENCY WARNING FLASHER OPERATION

(1966 Ford, Fairlane, Falcon and Mustang)

An electrical feedback phenomenon through the turn signal switch will occur on the subject vehicles when the following three situations are present simultaneously:

- The emergency warning light switch is in the "on" position.
- The ignition switch is in the "off" position.
- The turn signal switch is in either the left or right turn positions.

The electrical feedback will enable the driver to operate any of the electrical accessories which operate from the accessory terminal of the ignition switch such as, the radio or power windows without the ignition key. The operation of the accessories, however, will be intermittent. For instance, the power windows will "jerk" going up or down and the radio will emit an intermittent "bleeping" noise.

Owners should be instructed not to operate the emergency warning lights and the turn signals simultaneously. They should also be advised that no damage can occur to any of the electrical components because of the feedback.

BATTERY ACID ODOR IN PASSENGER COMPARTMENT

(1965 Econoline, Falcon Club Wagon)

If the odor of battery acid is encountered in the passenger compartment, it can be corrected by assuring that the correct cover placement and/or complete battery container position agrees with Figure 2. The following reference points should be checked:

1. Insure that the seal is cemented securely to the lower cover.
2. Insure that the floor vent holes are opened.
3. Position the upper cover to lower cover with rear edge under hold down edge on lower cover.
4. Hook latch under tab on lower cover and secure latch.

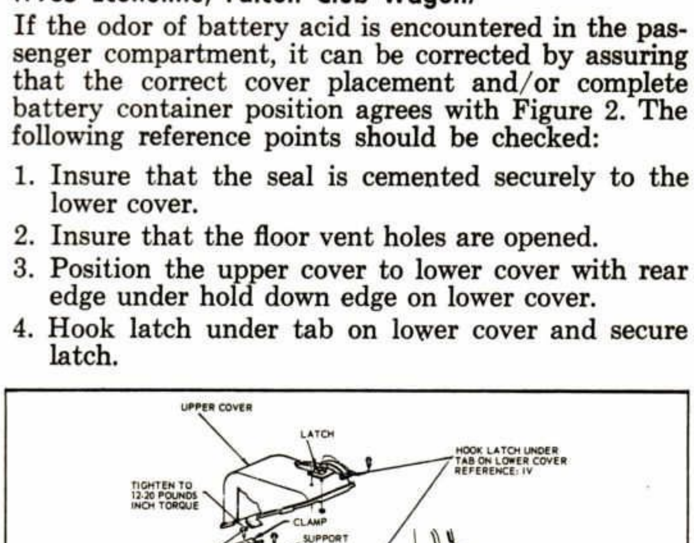


Figure 2—Battery Compartment—1965 Econoline

SERVICE BRIEFS

HARD STARTING

(1964 and 1965 Thunderbirds)

Hard starting problems on all models of the 1964 and '65 Thunderbirds may be caused by acid damage to the battery-to-starter relay cable Ford Part Number (C4SZ-14300-A). Acid damage is evident by discoloration (dark brown or black color) and/or a cable bulging condition. Damage will usually occur at any location where the cable is forced against the battery (as shown in Figure 3). If severely damaged, the cable should be replaced. Otherwise, it should be correctly positioned as shown in Figure 4.

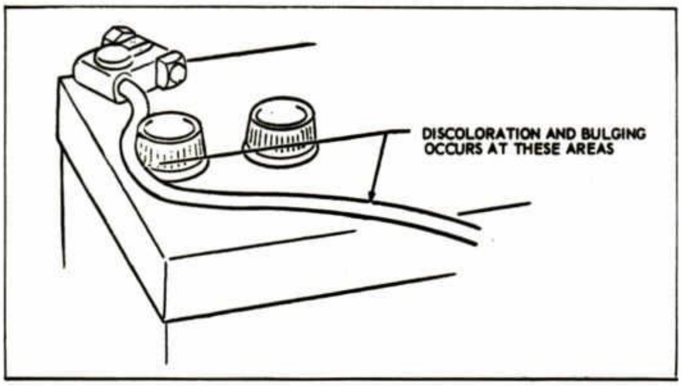


Figure 3—Incorrect Cable Routing

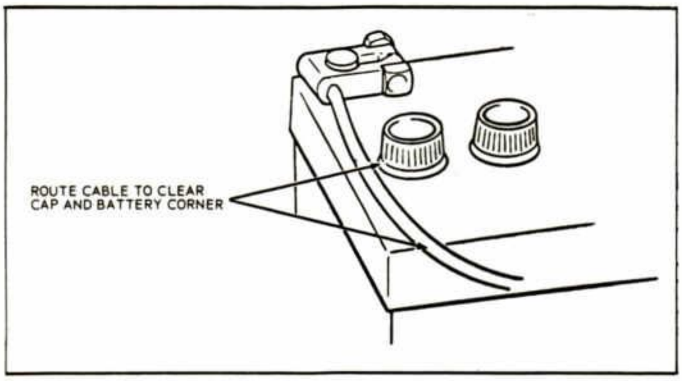


Figure 4—Correct Cable Routing

STARTER NOISE

(All 1964-65-66 Passenger Cars And Light Trucks)

If a starter is installed on an engine in a cocked position, it may bend the engine pilot plate and cause engagement interference between starter drive pinion and ring gear. This condition is readily identified by noisy starting, particularly a high pitched noise during overrun. In some instances this interference is severe enough to create starter lock up.

Proper diagnostic and corrective procedures for cocked or improperly mounted starters or for all suspected starter malfunctions are listed below:

1. Remove starter and examine drive gear for milled or chipped teeth. Replace drive assembly if teeth are milled or chipped.
2. Examine starter drive housing pilot surface for scar marks indicative of cocked starters—See Figure 5. Unless casting is cracked, drive housing may be reused.
3. Check pilot plate on engine for bent or damaged condition. Repair or replace as required.
4. Examine all teeth of ring gear and replace if a broken tooth condition exists or if milled as shown in Figure 5.

Starter installation should be done only according to the sequence listed below:

1. Insert starter into pilot hole, making sure that the starter housing pilot is seated for a full 360°.
2. Retain position of Step 1 and run in top bolt far enough to insure that starter cannot back out of pilot hole.
3. Run in lower bolt and tighten—then tighten top bolt—on three ear mount tighten middle bolt last.

Torque specifications: 18-25 lb. ft.

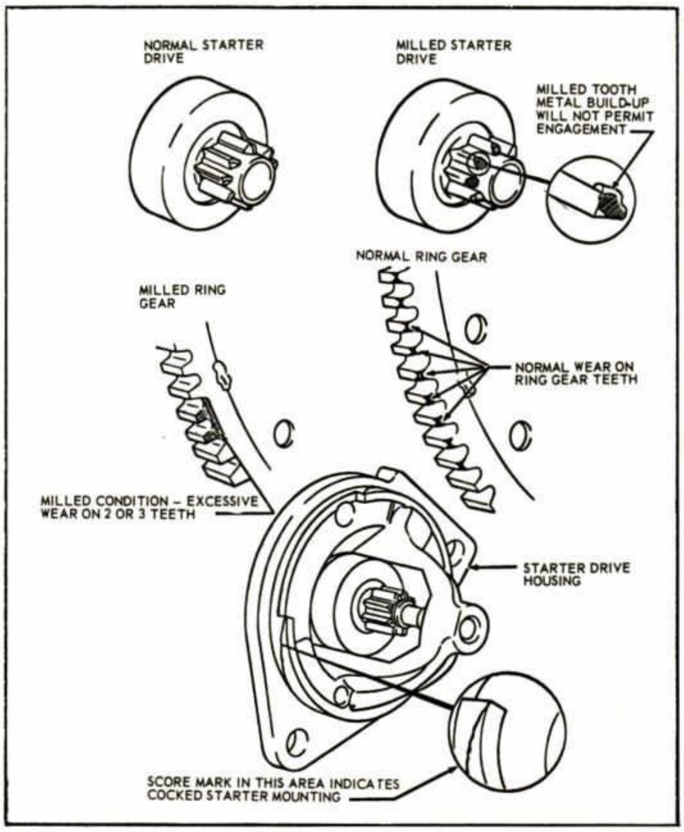


Figure 5—Starter Engagement

CLEANING CRANKCASE VENTILATION SYSTEMS

On some engines equipped with a positive crankcase ventiation (emission) system, an oil separator was incorporated in the ventilation outlet adapter on the crankcase. Maintenance of the positive crankcase system must include cleaning this separator as well as the hoses and fittings and replacing the regulator valve at the recommended intervals.

To service the oil separator, remove the adapter and crimp pack. Clean or replace the crimp pack. Failure to do so will greatly reduce the operating efficiency and service life of the engine.

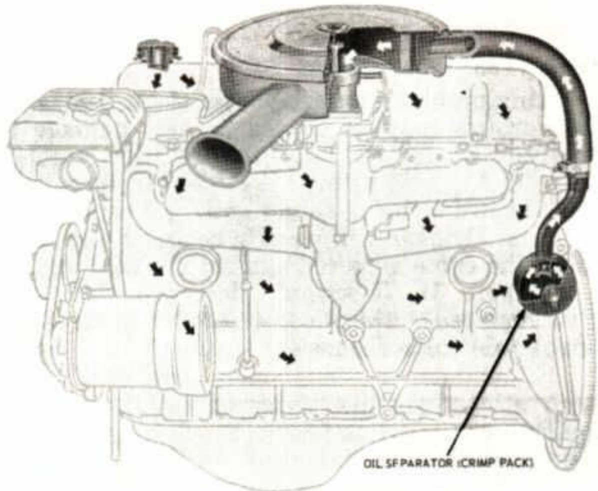


Figure 1—Typical PCV System—223 CID 6 Cyl Engine

CRANKCASE VENTILATION SYSTEM OIL SEPARATOR USAGE CHART

ENGINE	MODEL YEAR	TYPE OF OIL SEPARATOR	FIGURE
Serviceable Type			
223 Six	1963	Crimp Pack	1
221-260-289 V-8	1962-64	Crimp Pack	2
406 Hi Perf V-8	1962	Crimp Pack	2
427 Hi Perf V-8	1963-64	Crimp Pack	2
Non-Serviceable Except When Intake Manifold is Removed			
352 & 390 V-8	1958-64	Maze Screen	3

There are three basic types of oil separators incorporated in the positive crankcase ventilation system as shown in Figures 1, 2, and 3. Refer to the chart for the engine, model year and type of oil separator usage. Other engines (not listed) do not have a cleanable oil separator; thus, service of the positive crankcase ventilation system consists of replacing the regulator valve and cleaning of the hoses and fittings at the specified interval as described in the July-August 1965 Shop Tips.

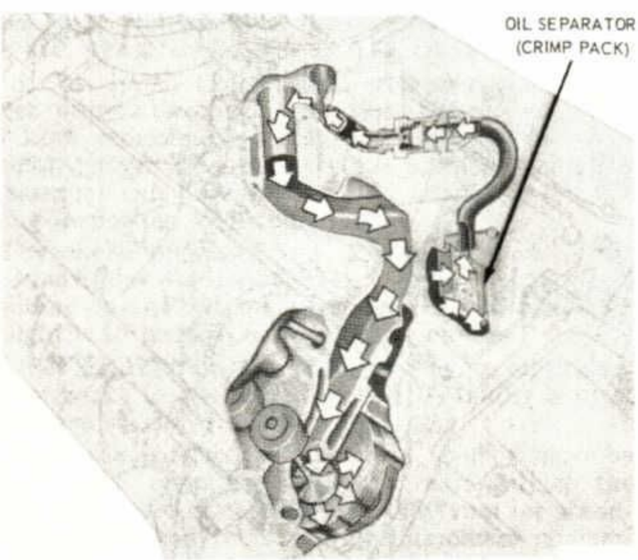


Figure 2—Typical PCV System—V-8 Engines with Non-Serviceable Oil Separator

Figure 3—Typical PCV System—V-8 Engines with Non-Serviceable Oil Separator

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