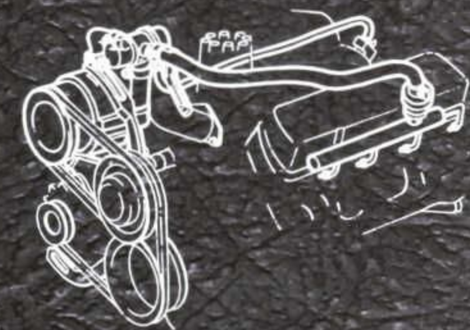
TRAINING HANDBOOK 5000

VEHICLE EMISSION Control Systems



REGISTERED TECHNICIAN

VOL. 68 S2 L2

VEHICLE EMISSION CONTROL SYSTEMS

TRAINING HANDBOOK 5000 VOL. 68 S2 L2

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NATIONAL SERVICE OFFICE

FORD DIVISION

Ford

FIRST PRINTING – AUGUST, 1967

ENGINE IDENTIFICATION AND APPLICATION

Passenger Car Engines	Wrty Plate Code	Ford	Mer-cury	Ford Police & Taxi	F'Lane	Mon-tego	Falcon	Mus-tang	Cou-gar	F'Lane Ranch-ero	F'Lane Taxi	Lin-coln	T'Bird	F-100	Bronco	Econo	IMCO	Thermactor	
																	Auto. Trans.	Auto. Trans.	Std. Trans.
170 Six 1-V	U						X										X		X
170 Six 1-V	F														X	X			X
200 Six 1-V	T				X	X	X	X		X	X						X		X
240 Six 1-V	V	X															X		X
240 Six 1-V	B			Police													X		X
240 Six 1-V	E			Taxi													X		X
240 Six 1-V	A															X	X		X
289 V-8 2-V	C				X		X	X									X		X
289 V-8 2-V	N														X				X
289 V-8 4-V (High Performance)	K							X										X	X
302 V-8 2-V	K															X	X		X
302 V-8 2-V	F	X		Police Taxi	X	X			X	X	X						X		X
302 V-8 4-V	J					X	X	X	X								X		X
390 V-8 2-V	Y	X	X		X	X				X							X		X
390 V-8 2-V (Premium Fuel)	X		X						X								X		
390 V-8 4-V	Z	X											X				X		X
390 V-8 4-V (GT)	S				X	X		X	X	X								X	X
427 V-8 4-V (High Performance)	W	X			X	X		X	X									X	
428 V-8 4-V	Q	X	X														X		X
428 V-8 4-V	P			Police														X	
429 V-8 4-V	N												X				X		
462 V-8 4-V	G											X					X		
Truck Engines																			
240 Six 1-V	A													X			X		X
300 Six 1-V	B													X			X		X
360 V-8	Y													X			X		X
390 V-8	H													X			X		X

NOTE: Engine applications for vehicles exceeding 6,000 GVW are not shown since emission control systems are not required on these units.

INTRODUCTION

Air pollution is a concern that is national in scope. This atmospheric condition, in one form or another, is to be found in varying degrees in many urban and industrial areas. The recent tremendous growth in population and fuel use has been a major contributing factor. The magnitude of this air pollution problem is evidenced by the legislation passed regulating the amount of air contaminants that industry and internal combustion engines can emit into the atmosphere.

Publicity, new laws and interest by regulatory bodies reflect the growing public awareness of the condition of the air we breathe. The extensive research and development efforts by Ford Motor Company evidence its interest in keeping the air we breathe more pure and safe. Ford continues to make analytical studies of the automobile's involvement to reduce or eliminate vehicle emission pollutants that may be detrimental to health.

Ford-built products represent advanced design and construction methods toward the solution of automotive air pollution problems as required by regulations of the Federal Department of Health, Education and Welfare. All 1968 Ford-built passenger cars and light trucks under 6,000 lbs. gross vehicle weight (GVW) built for registration in the United States are equipped with exhaust and crankcase emission control systems.

HISTORY AND DEVELOPMENT OF EMISSION CONTROLS

Ford Motor Company has, over a period of years, in cooperation with state and federal officials, carried on an extensive research, test, development and evaluation program to determine the most feasible approach for controlling vehicle emissions.

Approximately one-third of an automobile's total emissions come from the engine crankcase and since 1963 have been controlled by directing them back into the engine's intake manifold where they are consumed in the normal combustion process. Formerly, these crankcase vapors (blowby) were vented to the atmosphere through a road draft tube.

Technical advancements and modifications have continued as anti-pollution requirements have increased. Now Ford's vehicle emission control systems also include two types of exhaust emission control, the Thermactor system and the IMCO (Improved Combustion) system.

The Thermactor system is utilized on all engines with manual-shift transmissions. The IMCO system was developed for use on engines with automatic transmissions, except the 289 High-Performance V-8, 390 GT V-8, 427 V-8 and 428 Police Interceptor V-8 engines which use the Thermactor system. The "Engine Identification and Application Chart" provides a complete listing of engine and exhaust emission system availability.

CHARACTERISTICS OF EXHAUST EMISSION CONTROLLED ENGINES

Vehicle characteristics with vehicle emission control systems are no different from the characteristics noted in production of non-equipped vehicles. Slightly higher idle speeds are not of a magnitude that normal customer usage would find objectionable. All Ford vehicles are required to pass the Company Product Acceptance Standard Tests prior to production and these standards are generally the same as applied on non-equipped vehicles.

In all cases, complaints of improper operation should be verified. The diagnosis procedures outlined in this handbook must be performed to determine that there is a malfunction related to the emission control system.

SERVICE ADJUSTMENTS AND REPAIRS

Many service procedures, tests and adjustments have been changed from previous years, particularly in the ignition and fuel systems. To maintain the required exhaust emission levels, the carburetor air-fuel ratio must not be overly rich and the engine must be in good operating condition.

Research and development tests indicate that exhaust emission increases with various engine malfunctions. For example, a constant engine misfire caused by an open ignition wire, a cracked distributor cap or faulty spark plug will adversely affect vehicle emission levels.

When performing any service on the engine or emission control system, it is *essential* that the service procedures, maintenance and specifications be adhered to as recommended in this handbook.

MAINTENANCE SCHEDULE AND SPECIFICATIONS

Ford Motor Company installs the necessary automotive equipment to control vehicle air pollutants; *it is the responsibility of the owner to* *see that this equipment remains effective by maintaining it to the manufacturer's recommendations and specifications.*

The service requirements for vehicles equipped with emission systems are no more stringent than the normal maintenance required for non-equipped vehicles. The owner must be made aware of his obligations to obtain the scheduled checks and maintenance. A clogged air cleaner element may not seem important to the unknowing customer, but it is most detrimental to proper vehicle performance, fuel economy and emission control.

To maintain effective operation of these systems and to keep warranty in effect, the use of a high-grade motor oil with some new characteristics is *essential.* Ford 6000-mile motor oil is formulated to meet these requirements. If the customer prefers to use another brand, the oil used must meet the new Ford Motor Company performance specification, 101-B. *Evidence of use of 101-B is required for the customer to obtain the annual certification of his warranty.*

The purpose of this publication is to assist service technicians in the proper service and maintenance of the equipment to ensure its optimum performance for controlling vehicle emissions.

The maintenance schedule and service specifications that accompany this handbook are printed as separate publications so that they may be updated, as necessary, to incorporate the latest modifications to the systems.

CRANKCASE VENTILATION SYSTEM

DESCRIPTION AND OPERATION

The crankcase ventilation system has a closed, recirculating circuit that prevents engine crankcase fumes (vapors) or combustion gases from escaping through the engine oil filler or breather cap. During the combustion cycle of the engine, the charge of air-fuel mixture from the carburetor is compressed or squeezed into a smaller volume by the compression stroke of the piston. As the piston moves upward and downward, some of the air-fuel mixture and combustion gases (commonly called "blowby") slip by the piston rings into the engine crankcase. The crankcase ventilation system controls these fumes or vapors by directing them back into the intake manifold where they are consumed in the normal combustion process.

The crankcase ventilating air source is the carburetor air cleaner. The air passes through a hose connecting the air cleaner to the oil filler cap (Figs. 1 and 2). The oil filler cap is sealed at the filler opening to prevent the entrance of atmospheric air.

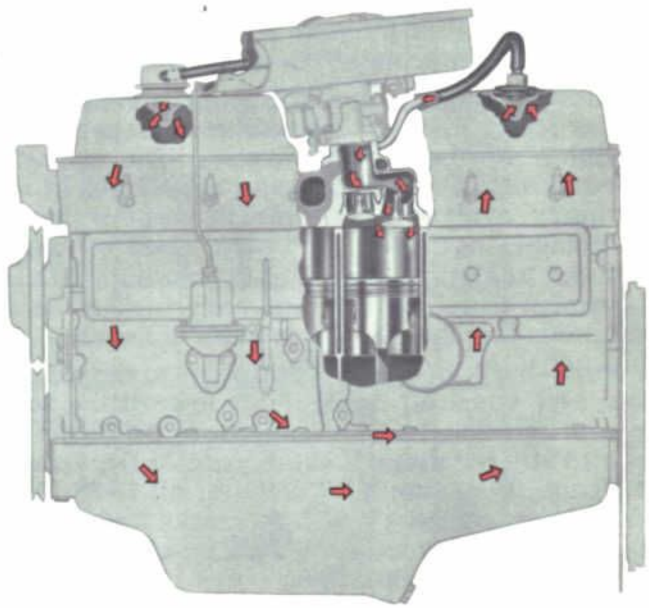


Fig. 1 — Typical Crankcase Ventilation System — 6-Cylinder Engine

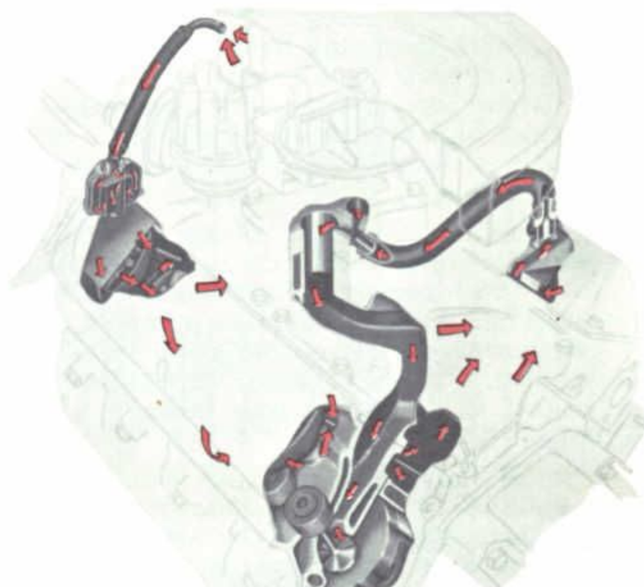


Fig. 2 — Typical Crankcase Ventilation System — V-8 Engine

From the oil filler cap, the air flows into the front section of the valve rocker arm chamber. The ventilating air moves down past the push rods into the lower crankcase.

The air flows towards the rear of the crankcase and up into the rear section of the valve rocker arm cover. The air and crankcase gases then enter a spring-loaded regulator valve that regulates the amount of flow to meet changing operating conditions (Fig. 3). The air and gas mixture is then directed to the intake manifold through the crankcase vent hose, tube and fittings.

During idle, intake manifold vacuum is high. The high vacuum overcomes the tension of the spring pressure and moves the valve to the *low-speed* operating position (Fig. 3). With the valve in this position, the ventilating air passes between the valve (jiggle pin) and the outlet port. With the valve in this position, there is minimum ventilation.

As engine speed increases and manifold vacuum decreases, the spring forces the valve to the *full-open* position (Fig. 3). This increases the flow of ventilating air.

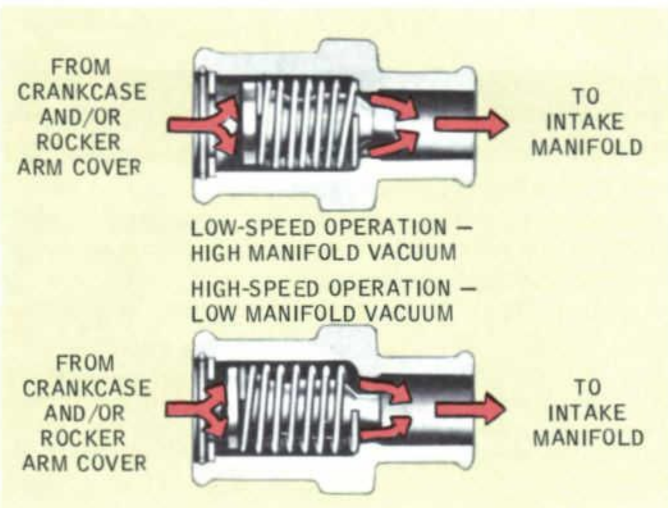


Fig. 3 — Crankcase Ventilation Regulator Valve Operation

DIAGNOSIS AND TESTS

A malfunctioning crankcase ventilation system may be indicated by loping or rough engine idle. Do not attempt to compensate for this idle condition by disconnecting the crankcase ventilation system and making carburetor adjustments. The removal of the crankcase ventilation system from the engine will adversely affect the fuel economy and engine ventilation, with resultant shortening of engine life.

To determine whether the loping or rough idle condition is caused by a malfunctioning crankcase ventilation system, perform either of the following tests:

Regulator Valve Test

Install a known good regulator valve in the crankcase ventilation system. Start the engine and compare the engine idle condition to the prior idle condition.

If the idle condition is found to be satisfactory, replace the regulator valve and clean the hoses, fittings, etc.

If the loping or rough idle condition remains when the good regulator valve is installed, the crankcase ventilation regulator valve is not at fault. Check the crankcase ventilation system for restriction at the intake manifold or carburetor spacer. If the system is not restricted, further engine component diagnosis will have to be conducted to find the malfunction. Refer to the "Vehicle Emission Control Systems Diagnosis Guide."

Air Intake Test

This test uses the AC crankcase ventilation tester (Fig. 4), which is operated by the engine vacuum through the oil fill opening. Perform the following procedures to install the tester and check the crankcase ventilation system for faulty operation.

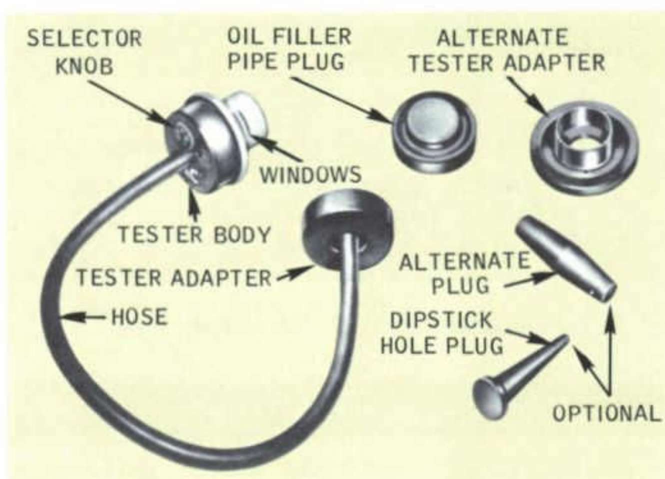


Fig. 4 — AC Crankcase Ventilation System Tester

1. *With the engine at normal operating temperature,* remove the oil filler cap and the dipstick.

2. Connect one end of the hose to the tester body and the other end to the tester adapter.

3. Use the oil level dipstick hole plug to close the opening in the dipstick tube.

4. Insert the tester adapter in the filler cap opening and turn the selector knob (Fig. 4) to number 2 for the 240 6-cylinder and V-8 engines or number 4 for the 170 and 200 6-cylinder engines.

5. Disconnect the air inlet hose at the oil filler tube or oil filler cap and plug the tube (or cap) and hose openings.

6. Start the engine and let it idle.

7. With the plugs secure, and the tube free of kinks, hold the tester body upright and note the "color" in the tester windows. The chart in Fig. 5 lists the various colors and the probable cause or related condition of the crankcase ventilation system.

8. Clean or replace the malfunctioning or defective components, and repeat the test to ensure that the crankcase ventilation system is operating satisfactorily.

CRANKCASE VENTILATION SYSTEM DIAGNOSIS WITH AC TESTER

COLOR	CAUSE
GREEN	SYSTEM OPERATING PROPERLY.
GREEN AND YELLOW	REGULATOR VALVE OR SYSTEM PARTIALLY PLUGGED. SLIGHT KINK IN TESTER HOSE. SLIGHT ENGINE BLOW-BY. PLUGS FROM THE KIT OR THE ENGINE VACUUM LINES ARE NOT PROPERLY SEALED. TESTER KNOB IMPROPERLY SET.
YELLOW	REGULATOR VALVE OR SYSTEM PARTIALLY PLUGGED. TESTER HOSE KINKED OR BLOCKED. BLOW-BY AT MAXIMUM CAPACITY OF REGULATOR VALVE. PLUGS FROM THE KIT OR THE ENGINE VACUUM LINES ARE NOT PROPERLY SEALED. TESTER KNOB IMPROPERLY SET.
YELLOW AND RED	REGULATOR VALVE OR SYSTEM PARTIALLY OR FULLY PLUGGED. MORE ENGINE BLOW-BY THAN REGULATOR VALVE CAN HANDLE. VENT HOSE PLUGGED OR COLLAPSED.
RED	REGULATOR VALVE OR SYSTEM FULLY PLUGGED OR STUCK. VENT HOSE PLUGGED OR COLLAPSED. EXTREME BLOW-BY.

Fig. 5 — Diagnosis of Air Intake Test

REMOVAL

Disconnect the vent hose at the carburetor spacer or intake manifold connection. Grasp the crankcase ventilation regulator valve and pull it straight upwards and out of the grommet in the valve rocker arm cover or oil separator. Remove the oil filler cap or oil separator (if so equipped), fittings, tubes or associated hardware.

On the Econoline, remove the oil separator from the air cleaner.

CLEANING

Do not attempt to clean the crankcase ventilation regulator valve; it must be replaced at the specified maintenance interval or as required.

The oil filler cap or oil separator (if so equipped) should be cleaned at the recommended mileage interval. Remove the cap or oil separator and wash it in a low-volatility petroleum base solvent. Shake the cap or oil separator to remove the cleaning solvent. Use care to avoid damaging the filter element.

Clean the crankcase ventilation system connection(s) on the carburetor spacer or intake manifold connection by probing with a flexible wire or bottle brush.

Clean the hose fittings, tubes or other associated hardware with a low-volatility petroleum-base solvent and dry with compressed air.

INSTALLATION

1. Install the crankcase ventilation system fittings, hoses and associated hardware.

2. Install the inlet hose on the regulator valve. Install the inlet hose on the carburetor spacer or intake manifold connection.

3. Install the crankcase ventilation regulator valve in the valve rocker arm cover or oil separator. Be sure the grommets and hoses are properly seated.

4. Install the air cleaner and oil filler cap vent hoses.

IMCO (IMPROVED COMBUSTION) EXHAUST EMISSION CONTROL SYSTEM

DESCRIPTION AND OPERATION

The IMCO (Improved Combustion) system was developed for vehicles equipped with automatic transmissions, except units with a 289 High-Performance V-8, 390 GT V-8, 427 V-8 and 428 Police Interceptor V-8 engines.

The IMCO system involves internal engine modifications of the induction and combustion systems to reduce the internal formation of hydrocarbon and carbon monoxide. In addition, carburetor and distributor changes provide lean carburetion and a retarded spark timing which promote a more complete consumption of the air-fuel mixture in the combustion chamber.

Essentially, the exhaust gas emissions are reduced in the combustion system rather than by burning the exhaust gases in the exhaust manifolds.

DIAGNOSIS, TESTS AND ADJUSTMENTS

The diagnosis procedures recommended for locating various malfunctions are detailed in the "Vehicle Emission Control System Diagnosis Guide." Refer to the "Fuel System" and "Ignition System" sections for the necessary test and adjustment procedures required for the IMCO equipped engines.

THERMACTOR EXHAUST EMISSION CONTROL SYSTEM

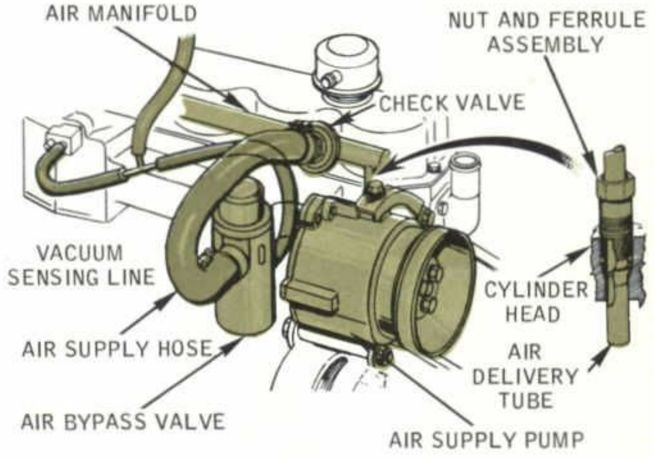
DESCRIPTION AND OPERATION

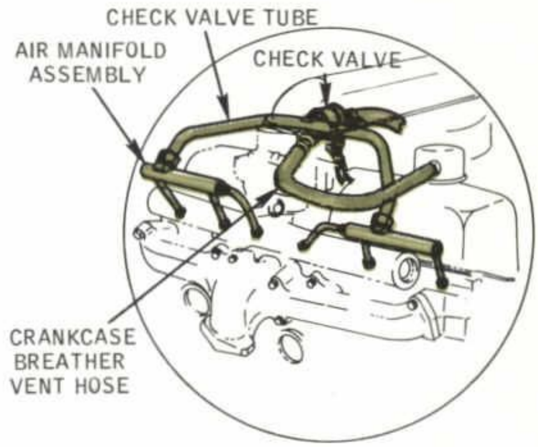
The Thermactor exhaust emission control system injects fresh air into the hot exhaust stream as it leaves the engine combustion chamber through the exhaust ports. At this point, the fresh air mixes with the hot exhaust gases and promotes further oxidation (burning) of both the hydrocarbons and carbon monoxide. This induced burning or oxidation lowers the concentrations of hydrocarbons and carbon monoxide, converting some of them into harmless carbon dioxide and water.

The Thermactor system consists of the following major components:

- Belt-driven air supply pump
- Air bypass valve
- Check valve(s)
- Internal or external air manifold(s)
- Air supply tubes (external air manifolds only)

Typical Thermactor system installations for the 6-cylinder and V-8 engines are shown in Figs. 6 and 7.





SPLIT-TYPE AIR MANIFOLD

Fig. 6 — Typical Thermactor System Installation — 6-Cylinder Engine

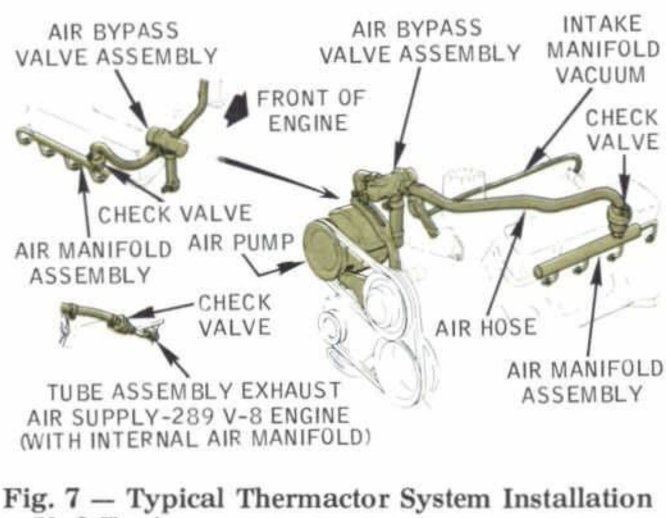


Fig. 7 — Typical Thermactor System Installation — V-8 Engine

THERMACTOR EXHAUST EMISSION CONTROL SYSTEM

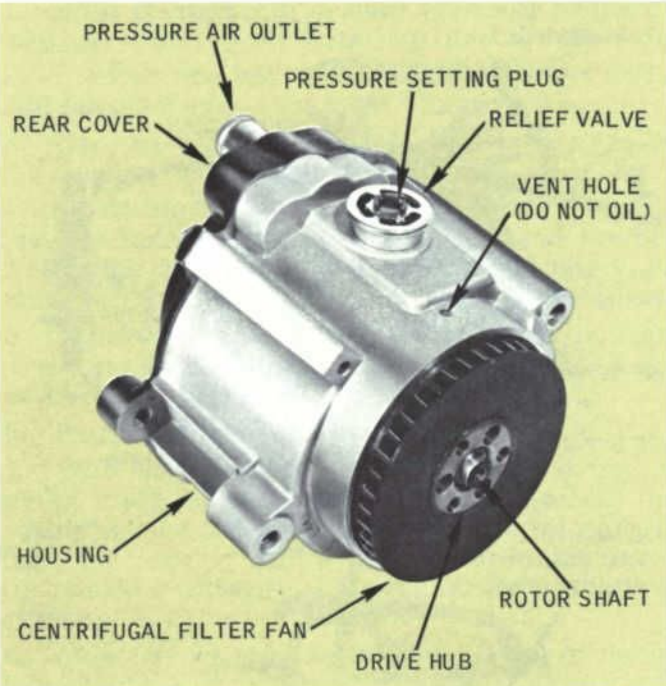


Fig. 8 — Thermactor Air Pump

Inlet air for the Thermactor system is cleaned by a centrifugal, filter fan mounted on the air pump drive shaft (Fig. 8), thus an element-type air cleaner (filter) is not required. A pressure relief valve is installed in the pump housing to prevent air pump outlet pressure from exceeding a predetermined value. The pressure setting of the relief valve is controlled by a replaceable plastic plug. The air pump bearings are sealed and lubricated with life-time lubricant. The rotor vane and bearing clearances are established during initial assembly, and no adjustment is required.

The air supply from the air pump is controlled by the air bypass valve. Normally, the air bypass valve is closed and the air is directed to the check valve(s) and air manifold(s) for distribution to the cylinder head exhaust ports (Figs. 9 and 10). During engine deceleration periods, the air bypass valve opens, and air delivery to the cylinder head ports is momentarily diverted to the atmosphere (Figs. 9 and 10).

A check valve is incorporated in the inlet air side of the air manifold(s) to prevent exhaust gas backflow into the air pump and air bypass valve during the air bypass cycle or drive belt or pump failure.

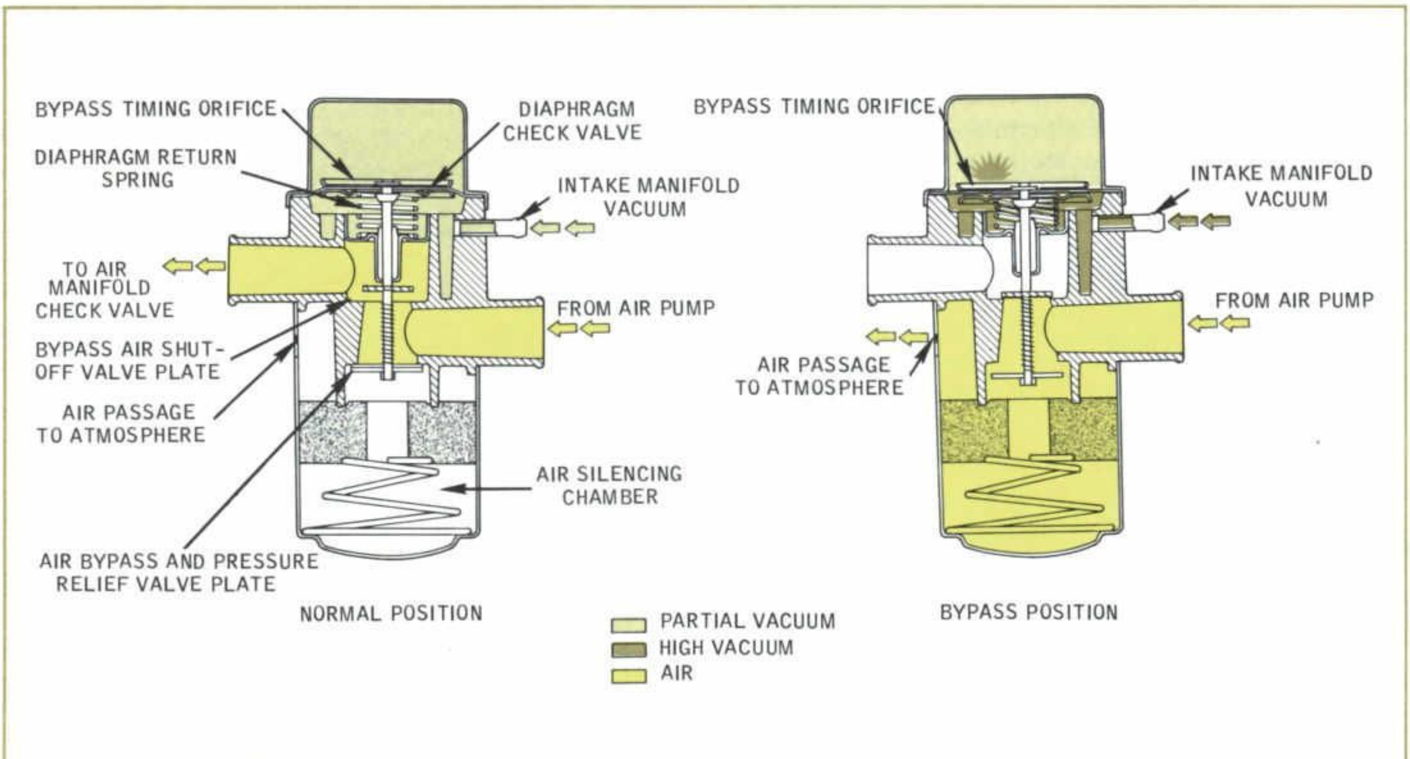


Fig. 9 — Air Bypass Valve Schematic — 6-Cylinder Engines

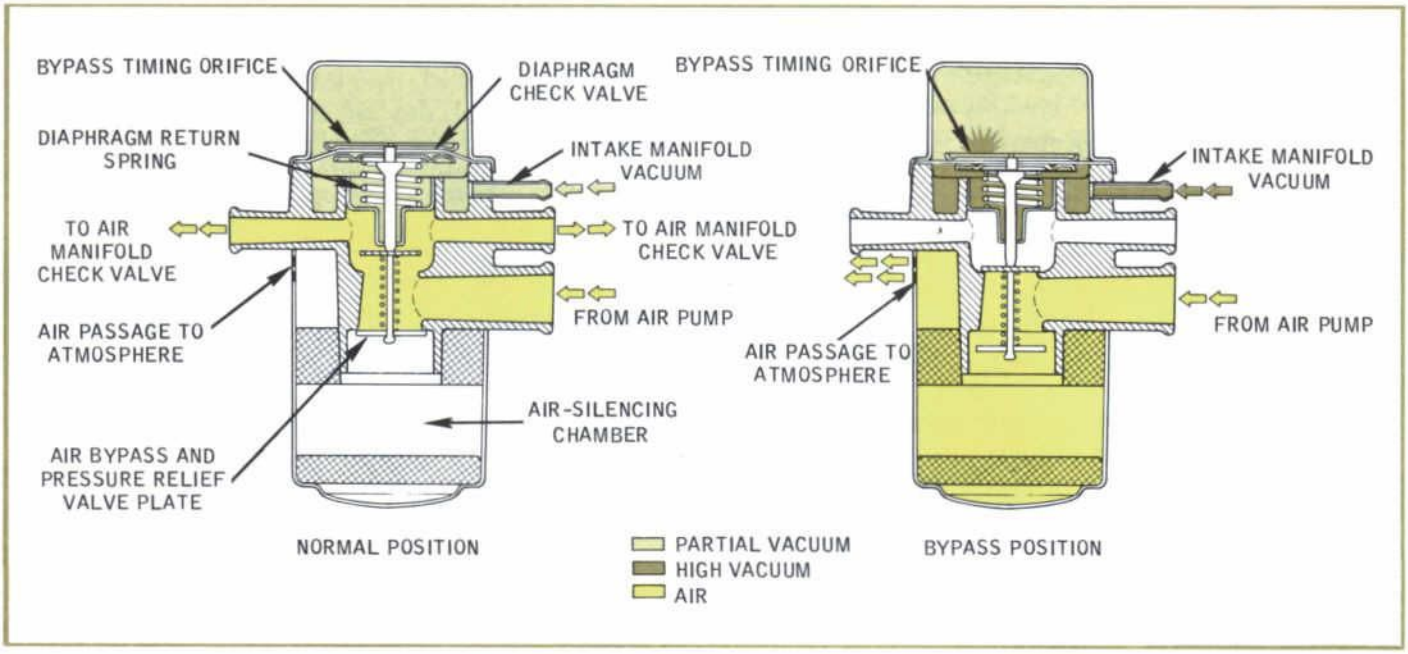


Fig. 10 — Air Bypass Valve Schematic — V-8 Engines

DIAGNOSIS AND TESTS

The following procedures are recommended for checking and/or verifying that the various components of the Thermactor exhaust emission control system are operating properly. *The engine and all components must be at normal operating temperatures when the tests are performed.* Refer to the "Vehicle Emission Control Systems Diagnosis Guide" as an aid in diagnosing the Thermactor exhaust emission control system.

Prior to performing any extensive test or diagnosis of the Thermactor system, verify that the problem exists: *then it must be determined that the engine as a unit is functioning properly.* Disconnect the air bypass valve vacuum-sensing line at the intake manifold. Plug the manifold connection to preclude leakage. Normal engine diagnosis procedures can then be performed.

Air Supply Pump Test

To test the air supply pump, a test gauge adapter (Fig. 11) must be fabricated so that the fuel pump test gauge used for this test can be installed on the adapter. Fabricate the test gauge adapter as follows:

- Obtain a 1/2-inch pipe tee, a 2-inch long piece of 1/2-inch galvanized pipe threaded on one end only, a 1/2-inch pipe plug, and a 1/2-inch reducer bushing or suitable gauge adapter.

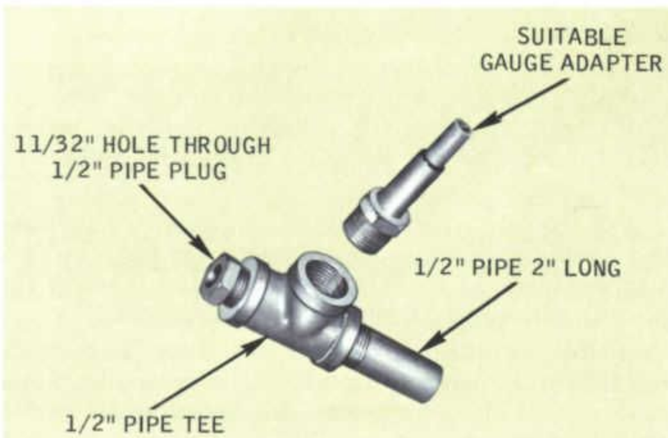


Fig. 11 — Air Supply Pump Test Gauge Adapter

- Apply sealer on the 2-inch long piece of 1/2-inch pipe and install it in one end of the pipe tee. Apply sealer on the O.D. threads of the 1/2-inch pipe plug and install it in the opposite end of the tee. Apply sealer on the O.D. threads of the 1/2-inch reducer bushing or adapter for the pressure gauge and install it in the side opening of the tee.
- Using a 11/32 (0.3437) diameter drill, drill a hole through the center of the pipe plug. Clean out the chips produced by drilling.

- Install a standard fuel pump testing gauge, or suitable pressure gauge in the side opening of the tee. The gauge must be accurate and readable in 1/4-psi increments.

The tool is ready now for use.

1. Operate the engine until it reaches normal operating temperature.
2. Inspect all hoses and hose connections for leaks and correct, as necessary, before checking the air pump.
3. Check the air pump belt tension and adjust the belt to specifications.
4. Disconnect the air supply hose(s) at the air manifold check valve(s). If there are two check valves, close off one hose by inserting a suitable plug in the end of the hose. *Use a hose clamp and secure the plug so that it will not blow out.*
5. Insert the open pipe end of the test gauge adapter in the other air supply hose. *Clamp the hose securely to the adapter to prevent it from blowing out.*

Position the adapter and test gauge so that the air blast emitted through the drilled pipe plug will be harmlessly dissipated.

6. Install a tachometer on the engine. Start the engine and slowly increase the engine speed to 1500 rpm. Observe the pressure produced at the test gauge. The air pressure should be one psi or more.
7. If the air pressure does not meet or surpass the above pressures, disconnect and plug the air supply hose to the air bypass valve. Clamp the plug in place, and repeat the pressure test.

If the air pump pressure still doesn't meet the minimum requirements, install a new air pump and repeat the pump test. Replace the air pump as determined by the result of this test.

Check Valve Test

This test can be performed at the same time as the "Air Pump Test."

1. Operate the engine until it reaches normal operating temperature.
2. Inspect all hoses and hose connections for obvious leaks and correct, as necessary, before checking the check valve operation.
3. Disconnect the air supply hose(s) at the check valve(s).
4. Visually inspect the position of the valve plate inside the valve body. It should be lightly positioned against the valve seat — away from the air manifold.
5. Insert a probe into the hose connection on the check valve and depress the valve plate. It should freely return to the original position, against the valve seat, when released.

If equipped with two check valve assemblies, check both valves for free operation.

6. Leave the hose(s) disconnected and start the engine. Slowly increase the engine speed to 1500 rpm and watch for exhaust gas leakage at the check valve(s). *There should not be any exhaust leakage.* The valve may flutter or vibrate at idle speeds, but this is normal due to the exhaust pulsations in the manifold.
7. If the check valve(s) does not meet the recommended conditions (steps 4, 5 and 6), replace it.

Air Bypass Valve Functional Tests

Determine if the air bypass valve (Fig. 12) is functioning properly by performing the following operation(s):

1. Remove the air bypass valve-to-air manifold check valve hose at the bypass valve hose connection.
2. With the transmission in Neutral and the parking brake ON, start the engine and operate it at normal engine idle speed. Verify that air is flowing from the air bypass valve hose connection. Air pressure should be noted as this is the normal delivery flow to the air manifold(s).
3. Momentarily (approximately five seconds) pinch off the vacuum hose to the bypass valve to duplicate the air bypass cycle.
4. Release the pinched vacuum hose. Air flow through the air bypass valve should diminish or stop for a short period of time. The length of time required to resume normal flow cannot be specified since the time interval is dependent on engine vacuum and length of time the vacuum line is pinched off.
5. Evaluate the bypass valve for diaphragm leakage by performing the following check:

Remove the vacuum supply hose to the air bypass valve at the bypass valve connection. Insert a tee connection in the vacuum supply hose. Connect a vacuum gauge to one of the remaining hose connections on the tee, insert a short length of hose (approximately three inches) on the remaining connection. Insert a suitable plug in the open end of the short length of hose.

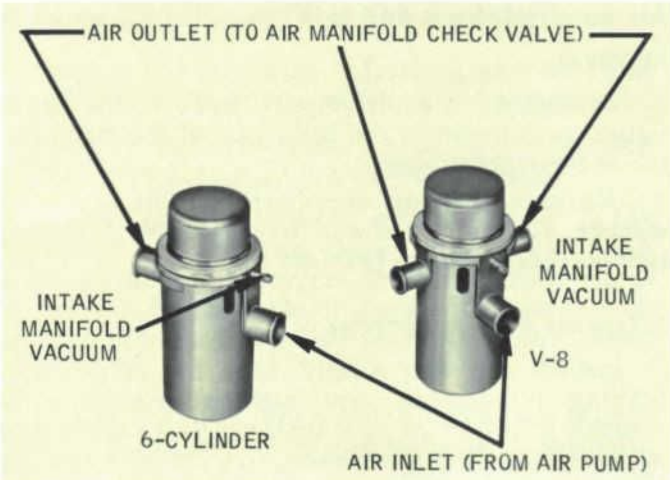


Fig. 12 — Thermactor Air Bypass Valve

Start the engine and note the vacuum gauge reading. Remove the plug from the short length of hose and connect the hose to the air bypass valve vacuum connection. Observe the vacuum gauge reading. If the indicated vacuum reading does not correspond with the previous reading after approximately 60 seconds, replace the air bypass valve.

ADJUSTMENTS

Thermactor Air Pump Drive Belt Adjustment

The air pump drive belt should be properly adjusted at all times (Fig. 13). A loose drive belt causes improper air pump operation. A belt that is too tight places a severe strain on the air pump bearings.

Properly tensioned drive belts minimize noise and also prolong service life of the belt. Therefore, it is recommended that a belt tension gauge be used to check and adjust the belt tension. *Any belt that has operated for a minimum of 10 minutes is considered a used belt, and, when adjusted, it must be adjusted to the tension shown in the specifications for used belts.*

1. Install the belt tension gauge (T63L-8620-A) on the drive belt and check the tension (Fig. 14) following the instructions of the tool manufacturer. Compare the belt tension to the specified belt tension and adjust as necessary.
2. If adjustment is necessary, loosen the air pump mounting and adjusting arm bolts (Fig. 13). Move the air pump toward or away from the engine until the correct tension is obtained. *Use a suitable bar and pry against the pump rear cover* to hold belt tension while tightening the mounting bolts. *Do not pry against the pump housing.* Remove the gauge. Tighten the air pump adjusting arm and mounting bolts. Install the tension gauge and check the belt tension.

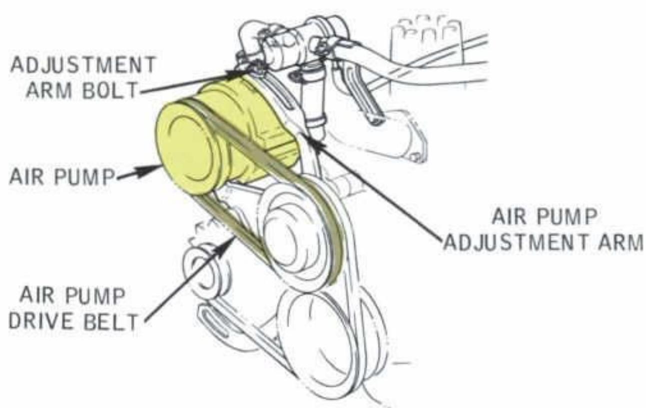


Fig. 13 — Typical Drive Belt Arrangement

REMOVAL AND INSTALLATION

Air Pump Drive Belt Replacement

1. Loosen the air pump adjusting arm bolt (Fig. 13). Loosen the air pump-to-mounting bracket bolt, and push the air pump towards the cylinder block. Remove the drive belt.
2. Install a new drive belt. With a suitable bar, *pry against the rear cover of the air pump* to obtain the specified belt tension, and tighten the adjusting arm bolt. *Do not pry against the pump housing.* Check and adjust the belt tension, as necessary, to be sure it is within specifications. *Always use a belt tension gauge (Tool T63L-8620-A) to check belt tension (Fig. 14).*

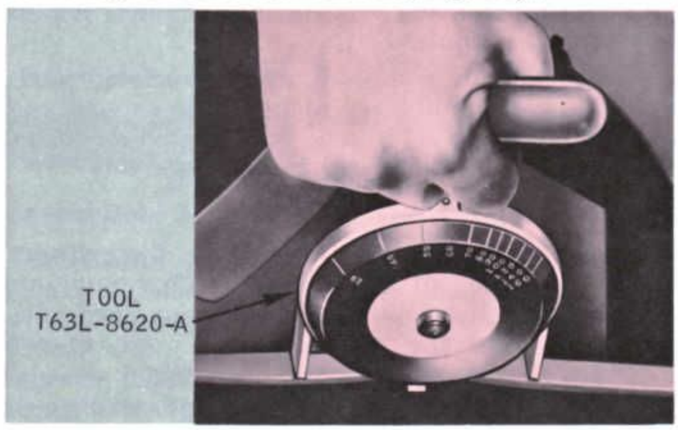


Fig. 14 — Drive Belt Tension Check

3. Tighten the air pump-to-mounting bracket bolt.

Air Bypass Valve Replacement

1. Disconnect the air and vacuum hoses at the air bypass valve body.
2. Position the air bypass valve properly, and connect the air and vacuum hoses.

Check Valve Replacement

1. Disconnect the air supply hose at the valve. Use a 1-1/4 inch crowfoot wrench to unscrew the check valve assembly (the valve has a standard, right-hand pipe thread).

2. Clean the threads on the air manifold adapter (air supply tube on 289 V-8) with a wire brush. *Do not blow compressed air through the check valve in either direction.* Install the check valve and torque it to specifications. Connect the air supply hose.

Air Manifold — Except 289 V-8

REMOVAL

1. Disconnect the air supply hose at the check valve and position the hose out of the way. Remove the check valve.

2. Loosen all of the air manifold-to-cylinder head tube coupling nuts (compression fittings). Then unscrew each one until it is free of the cylinder head. Grasp the air manifold at each end and pull it away from the cylinder head. Follow the same procedure to remove the other air manifold, if the engine is so equipped.

CLEANING AND INSPECTION

Inspect the air manifold for damaged threads and fittings and for leaking connections. Repair or replace as required.

Clean the air manifold and associated parts with a low-volatility, petroleum-base solvent and a suitable stiff bristle brush. Dry the cleaned parts, except the check valve, with compressed air.

INSTALLATION

1. Position the air manifold(s) on the cylinder head. Be sure all the tube coupling nuts are aligned with the cylinder head. Screw each coupling nut into the cylinder head, one to two threads. Tighten the tube coupling nuts.

2. Install the check valve and torque it to specifications. Connect the air supply hose to the check valve.

Air Supply Tube — 289 V-8

REMOVAL

1. Disconnect the air supply hose at the check valve, and position the hose out of the way. Remove the check valve.

2. Remove the air supply tube bolt and seal washer. Carefully remove the air supply tube and seal washer from the cylinder head.

CLEANING AND INSPECTION

Inspect the air supply tube for evidence of leaking threads or seal surfaces. Examine the attaching bolt head, seal washers and supply tube surface for evidence of leaks. Inspect the attaching bolt and cylinder head threads for damage.

Clean the air supply tube, seal washers and bolt with a low-volatility, petroleum-base solvent. Dry the cleaned parts, except the check valve, with compressed air.

INSTALLATION

1. Install the seal washer and air supply tube on the cylinder head. Be sure it is positioned the same as it was before removal. Install the seal washer and mounting bolt, and torque the bolt to specifications.

2. Install the check valve and torque it to specifications. Connect the air supply hose to the check valve.

Air Nozzle Replacement — Except 289 V-8

Normally, air nozzles should be replaced, as necessary, during cylinder head overhaul. A nozzle may be replaced without removing the cylinder head, by removing the air manifold and using a hooked tool to pull the nozzle.

Clean the nozzles with a low-volatility, petroleum-base solvent and stiff bristle brush. Inspect the air nozzles for eroded tips.

Air Pump Drive Pulley Replacement

1. Loosen the air pump adjusting arm and mounting bolts to relieve the belt tension.

2. Remove the drive pulley attaching bolts and pull the drive pulley off the air pump shaft.

3. Position the drive pulley on the air pump shaft, and install the retaining bolts. Torque the bolts to specifications.

4. Position the drive belt and adjust the belt tension to specifications. Tighten the adjusting arm and mounting bolts.

dency of carburetor icing before the engine reaches normal operating temperature.

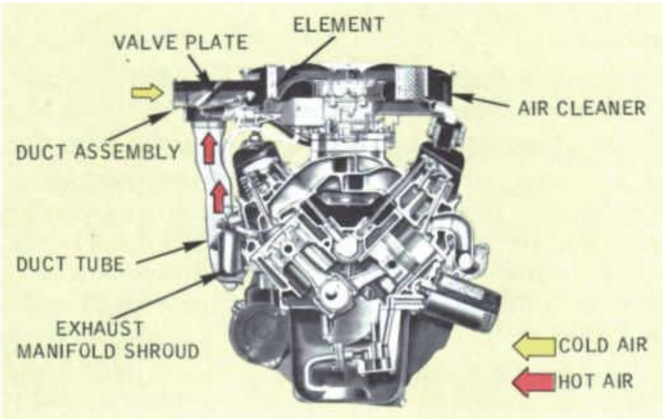


Fig. 16 — Typical Air Intake System Installation

The temperature of the carburetor intake air is thermostatically controlled by means of a valve plate and a vacuum override built into a duct assembly (Fig. 17) attached to the air cleaner. The exhaust manifold shroud tube is attached to a shroud over the exhaust manifold for the source of heated air. The duct has an opening at the outer end to permit the entry of cooler air from the engine compartment. The thermostatic bulb within the duct and the vacuum override motor attached to the duct and connected to the thermostat lever provide the means to balance the air temperature for various engine operating conditions.

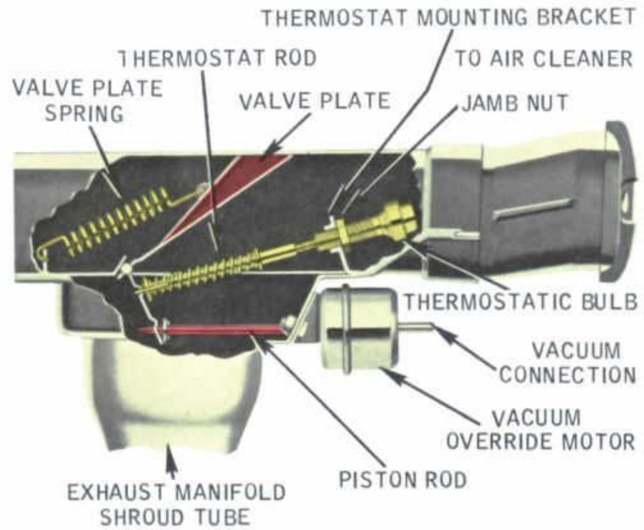


Fig. 17 — Sectional View of Hot and Cold Air Cleaner Duct and Valve

During the engine warm-up period when the air temperature entering the air duct is less than 100 degrees F., the thermostat is in the *retracted position* and the valve plate is held in the *heat-on position* (up) by the valve plate spring, thus shutting off the air from the engine compartment. All air is then drawn from the shroud around the exhaust manifold (Fig. 18).

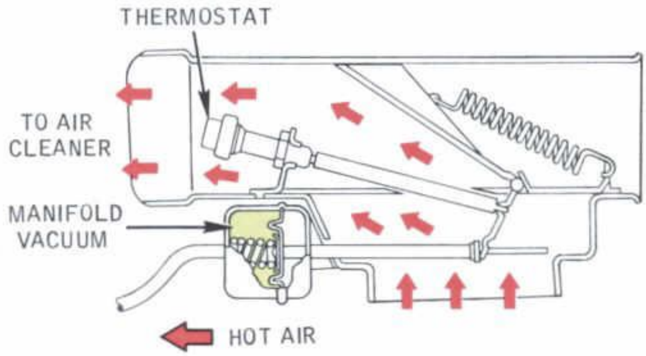


Fig. 18 — Duct and Valve Assembly in Heat-On Position — Warm-Up

During cold acceleration periods, additional carburetor intake air is provided by the vacuum motor control. The decrease in intake manifold vacuum during acceleration permits the vacuum motor to override the thermostat control. This opens the system to both engine compartment air and heated air from the exhaust manifold shroud (Fig. 19).

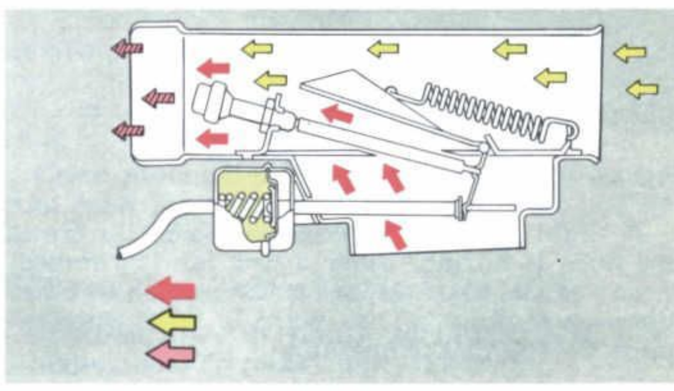


Fig. 19 — Duct and Valve Assembly in Partial Heat-On Position — Cold Acceleration

As the temperature of the air passing the thermostatic bulb increases, the thermostat starts to expand, and forces the valve plate down. This allows cooler air from the engine compartment to enter the air cleaner. When the air reaches maximum temperature, the valve plate will be in the *heat-off position* (down) so that only engine compartment air is allowed to enter the air cleaner (Fig. 20).

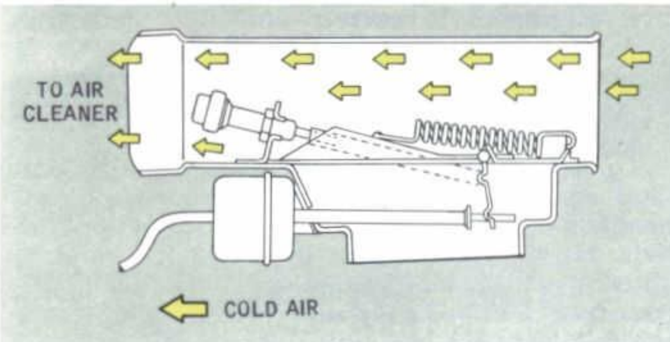


Fig. 20 — Duct and Valve in Heat-Off Position — Warm Engine

The 390 GT V-8 engine is equipped with a similar duct and valve assembly that operates in the same manner as on other engines, except the vacuum override is not used. Instead of the vacuum override, a vacuum motor is installed on the perimeter of the air cleaner. When manifold vacuum is low, during heavy engine loading or high-speed operation, a spring in the vacuum motor opens the motor valve plate into the air cleaner (Fig. 21). This provides the optimum air supply for greater volumetric efficiency during full-power operation.

DIAGNOSIS AND TESTS

Hot and Cold Air Intake System

Failure of this system to function will not affect the vehicle's exhaust emission but may affect driveability.

To determine whether the system is functioning properly, the following procedure should be used:

DUCT AND VALVE ASSEMBLY WITHOUT OVERRIDE SYSTEM — EXCEPT 390 GT V-8

1. With the duct assembly installed on the vehicle, cold engine, and ambient temperature in the engine compartment of less than 100 degrees F., the valve plate should be in the *heat-on position* (Fig. 18).
2. If the plate is not in the *heat-on position*, check for possible interference of plate and duct which would cause the plate to hang-up in its given travel. Correct, if interference is present, by re-aligning the plate.
3. Remove the duct and valve assembly from the vehicle.
4. Immerse the duct assembly in water so that the thermostat capsule is covered with water.
5. Raise the water temperature to 100 degrees F., allow five minutes to stabilize the temperature, and observe the valve plate position. The valve plate should be in the *heat-on position* (Fig. 18).
6. Increase the water temperature to 135 degrees F., allow five minutes to stabilize the temperature, and observe the valve plate position. The valve plate should be in the *heat-off position* (Fig. 20).

If the valve plate does not meet the requirements as outlined in steps 5 and 6, and no interference is observed between the plate and duct, the duct and valve assembly should be replaced.

DUCT AND VALVE ASSEMBLY WITH VACUUM MOTOR ATTACHED DIRECTLY TO AIR CLEANER — 390 GT V-8 ONLY

In addition to checking the duct and valve assembly, the vacuum motor that is attached to the air cleaner should be checked for functional operation.

1. Start the engine, and observe the vacuum motor plate. It should be fully closed (Fig. 21).
2. Disconnect the vacuum hose at the vacuum motor. The plate should be in the *full-open position* (Fig. 21).
3. If the positions as described, are not obtained, check for interference and alignment of the plate and motor rod, and check for vacuum from hose at the vacuum motor (minimum of 15 inches Hg).

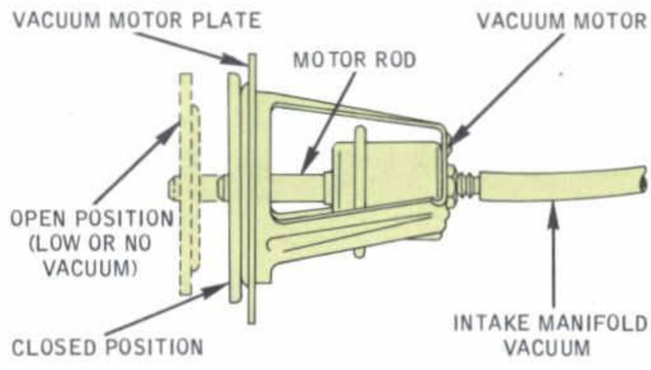


Fig. 21 — 390 GT V-8 Air Valve and Vacuum Motor Assembly

If vacuum is not available, check the hose and connection for leaks.

4. If the vacuum motor plate still remains in one position, remove the vacuum motor from the air cleaner, connect it to another vacuum source to confirm that the vacuum motor is not operating. If the motor rod does not move when vacuum is applied, the vacuum motor is not functional and should be replaced.

5. Reassemble the motor to the air cleaner and repeat steps 1 and 2.

DUCT AND VALVE ASSEMBLY WITH OVERRIDE SYSTEM – ALL EXCEPT 390 GT V-8

1. With the duct assembly installed on the vehicle, cold engine, and ambient temperature in the engine compartment less than 100 degrees F., the valve plate should be in approximately *one-half heat-on position* (Fig. 19).

2. If the plate is not in the above position, check for possible interference of plate, duct, and/or vacuum motor which would cause the plate to hang-up in its given travel. Correct, if interference is present, by realigning the plate or vacuum motor as required.

3. Start the engine, and observe the valve plate position while the engine is still cold. The correct position for the plate is in the full *heat-on position.* Align the plate or vacuum motor if interference is noted.

4. If the valve plate remains only in the *one-half heat-on position* as observed in step 1, remove the vacuum hose at the override vacuum motor and check for vacuum at the hose (minimum of 15 inches Hg at idle).

5. If the vacuum is less than 15 inches Hg, check for vacuum leaks in the hose and hose connection.

6. When the vacuum meets specifications, reconnect the hose to the override motor and again with the underhood temperature less than 100 degrees F., observe the valve plate position.

7. If the plate still remains only in the *one-half heat-on position* and there is no interference between the valve plate, duct, or vacuum motor rod, the vacuum motor should then be removed and connected to another vacuum source.

8. If the motor rod moves a minimum of 1/2 inch, the motor is functional and should be reassembled into the duct assembly, and a check for interference and misalignment and a check of the thermostat bulb should be made.

If the motor rod does not move a minimum of 1/2 inch, the vacuum motor is not functional and should be replaced. After assembling the replacement motor into the duct assembly, a check should be made as outlined in steps 1 through 5 to be sure alignment is correct and no interference exists.

CARBURETOR ADJUSTMENTS

To help assure that 1968 Ford Motor Company vehicles operate within the limits of government regulations governing exhaust emission, all carburetors are equipped with idle fuel mixture adjustment limiters. The limiters control the maximum idle fuel richness and help prevent unauthorized persons from making overly rich idle adjustments. There are two types of idle limiters: external and internal.

The external-type plastic idle limiter cap installed on the head of the idle fuel mixture adjusting screw(s) is used on all Autolite and the 4-V Carter carburetors. Any adjustment made on carburetors having this type of limiter must be within the range of the idle adjusting limiter. *Under no circumstances are the idle adjusting limiters or the limiter stops on the carburetor to be mutilated or deformed to render the limiter inoperative.* On Autolite models 2100 2-V and 4100 4-V carburetors, the power valve cover must be installed with the limiter stops on the cover in position to provide a positive stop for the tabs on the idle adjusting limiters. A satisfactory idle should be obtainable within the range of the idle adjusting limiters if all other engine systems are operating within specifications.

The internal needle-type limiter used on the Carter 1-V and Holley 4-V is located in the idle channel which is not externally visible. The limiter is installed and sealed during manufacture.

At pre-delivery, follow the "Normal Idle Fuel Settings for both Engine Off and Engine On," and step 1 of "Additional Idle Speed and Fuel Mixture Procedures." Other fuel system adjustments should not be required at pre-delivery service.

Following are the normal procedures necessary to properly adjust the engine idle speed and fuel mixture. The specific operations should be followed in the sequence given whenever the idle speed or idle fuel adjustments are made.

In isolated cases, a satisfactory idle condition may not be achieved by performing the normal procedures. If this occurs, refer to "Additional Idle Speed and Fuel Mixture Procedures."

Normal Idle Fuel Settings – Engine Off

1. On Autolite (all models) and Carter 4-V carburetors, set the idle fuel mixture screw(s) and limiter cap(s) to the full-counterclockwise position of the limiter cap(s) as illustrated in Fig. 22.

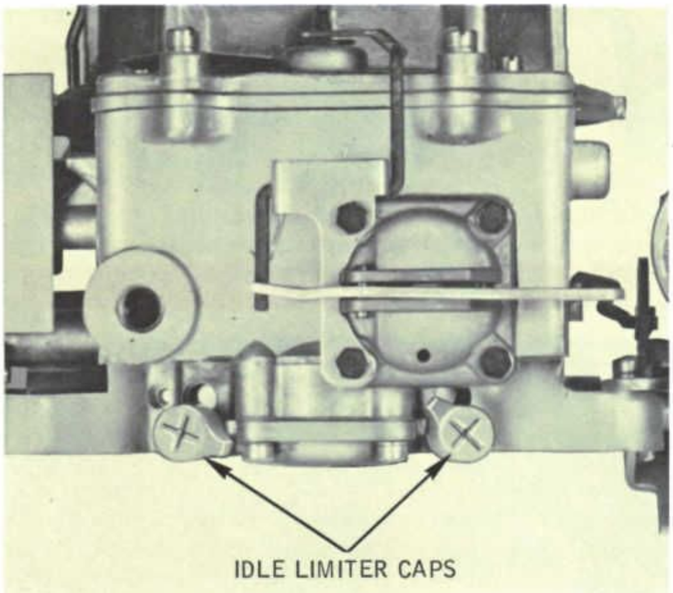


Fig. 22 — Idle Fuel Mixture Limiter Caps — Autolite Carburetors

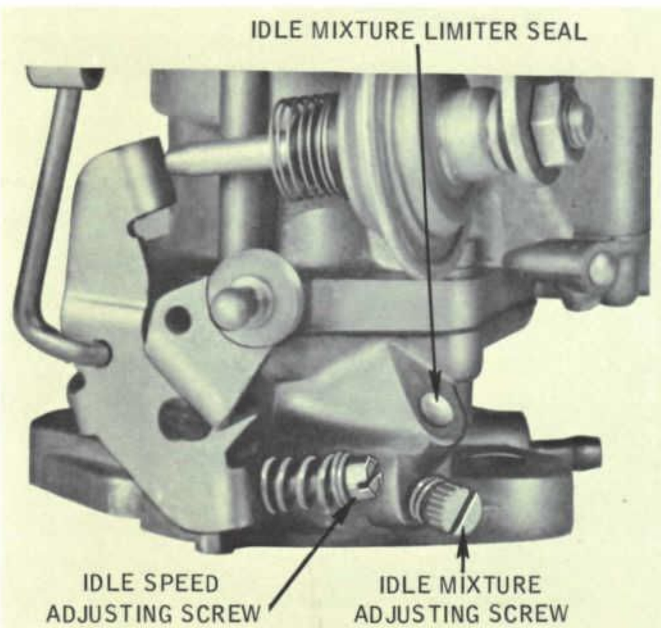


Fig. 23 — Idle Fuel Mixture Adjusting Screw — Carter 1-V

On Carter 1-V (Fig. 23) and Holley 4-V (Fig. 24) carburetors, establish an initial idle mixture screw setting by turning the screw inward until it is lightly seated; then turn it outward 1 to 1-1/2 turns. Do not turn the screw(s) tightly against the screw seat, as this may damage the end of the screw. If the screw end is damaged, the screw must be replaced before a satisfactory adjustment can be obtained.

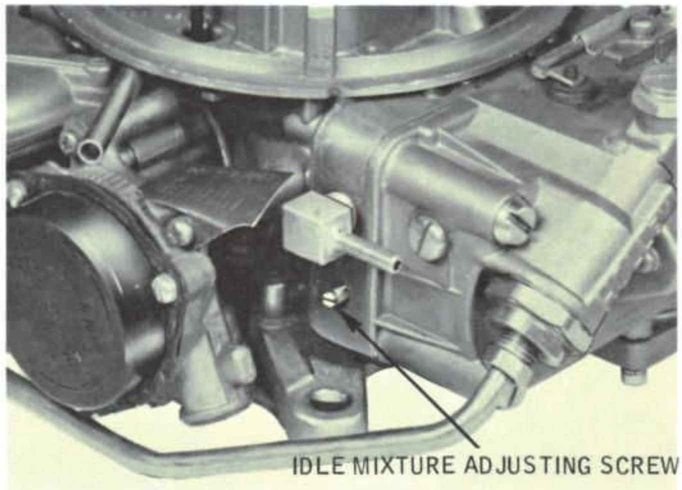


Fig. 24 — Idle Fuel Mixture Adjusting Screws — Holley 4-V

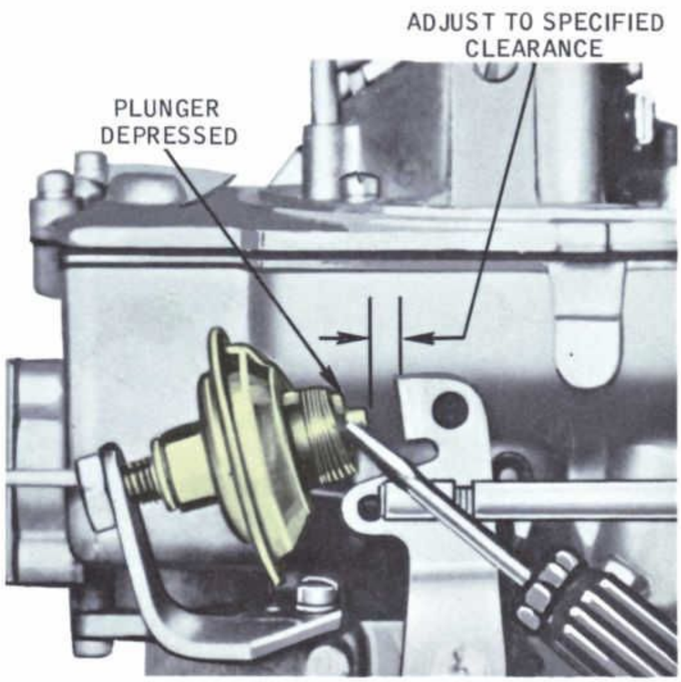
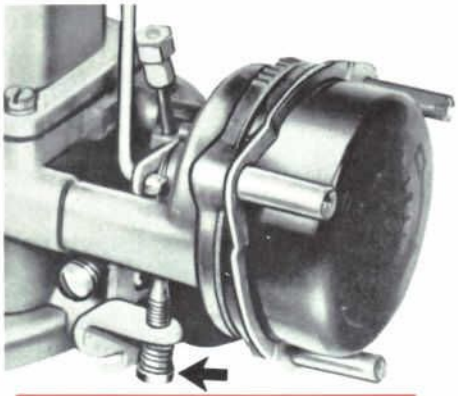
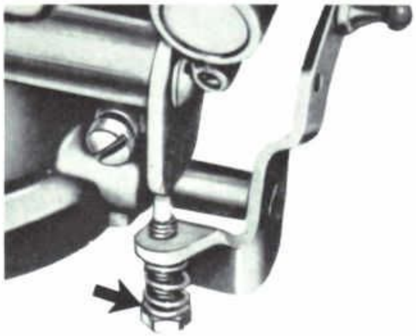


Fig. 25 — Typical Dashpot Installation

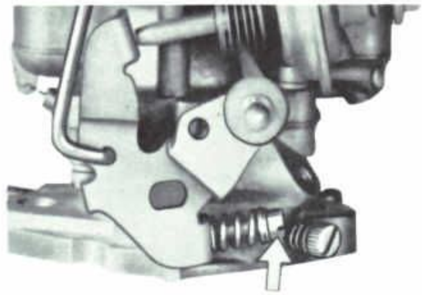
PASSENGER CARS



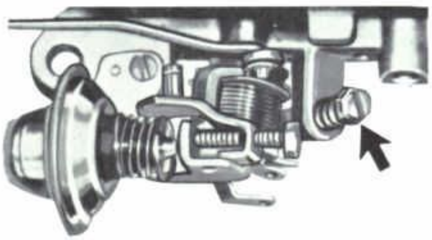
AUTOLITE MODEL 1100 1-V



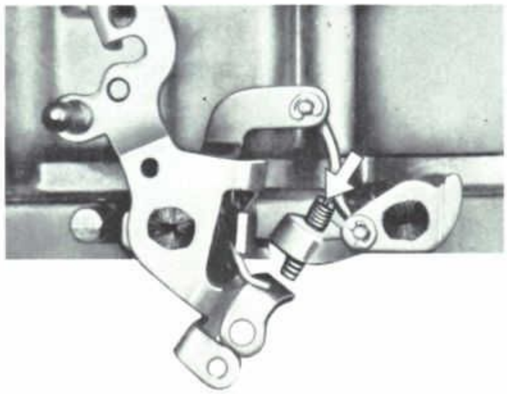
AUTOLITE MODEL 1101 1-V



CARTER MODEL YF 1-V



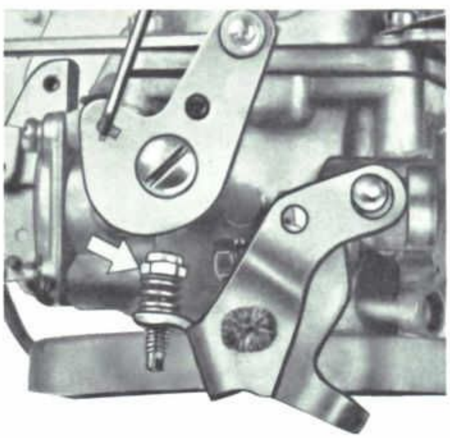
AUTOLITE MODELS 2100 2-V AND 4100 4-V



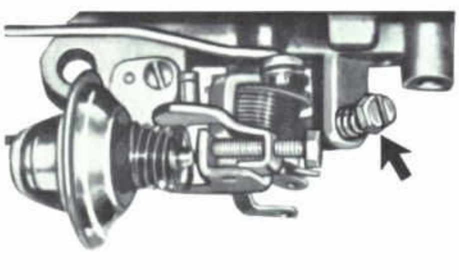
AUTOLITE MODEL 4300 4-V

HOLLEY MODEL 4150 4-V

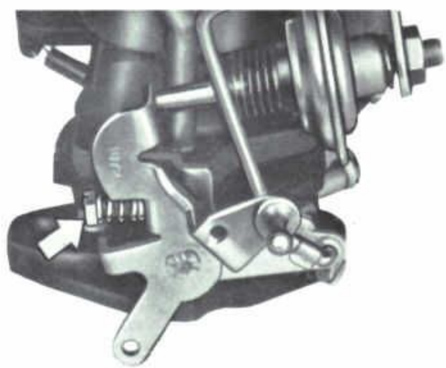
LIGHT TRUCKS (UNDER 6000 GVW)



AUTOLITE MODEL 1100 1-V



AUTOLITE MODEL 2100 2-V



CARTER MODEL YF 1-V

Fig. 26 — Idle Speed Adjusting Screws

2. Back off the idle speed adjusting screw until the throttle plate(s) seat in the throttle bore(s).

3. Be sure the dashpot (if so equipped) is not interfering with the throttle lever (Fig. 25). It may be necessary to loosen the dashpot to allow the throttle plate to seat in the throttle bore.

4. Turn the idle speed adjusting screw (except Thunderbird and Lincoln) inward until it just makes the contact with the screw stop on the throttle shaft and lever assembly. Then turn the screw inward 1-1/2 turns to establish a preliminary idle speed adjustment (Fig. 26).

Turn the idle air adjusting screw (Thunderbird and Lincoln) inward until it lightly seats, then turn the screw outward 3-1/2 turns (Figs. 27 and 28).

5. Set the parking brake before making the idle mixture and speed adjustments. On a vehicle with a vacuum release parking brake, remove the vacuum line from the power unit of the vacuum release parking brake assembly. Plug the vacuum line, then set the parking brake. The vacuum power unit must be deactivated to keep the parking brake engaged when the engine is operated with the transmission in "Drive."

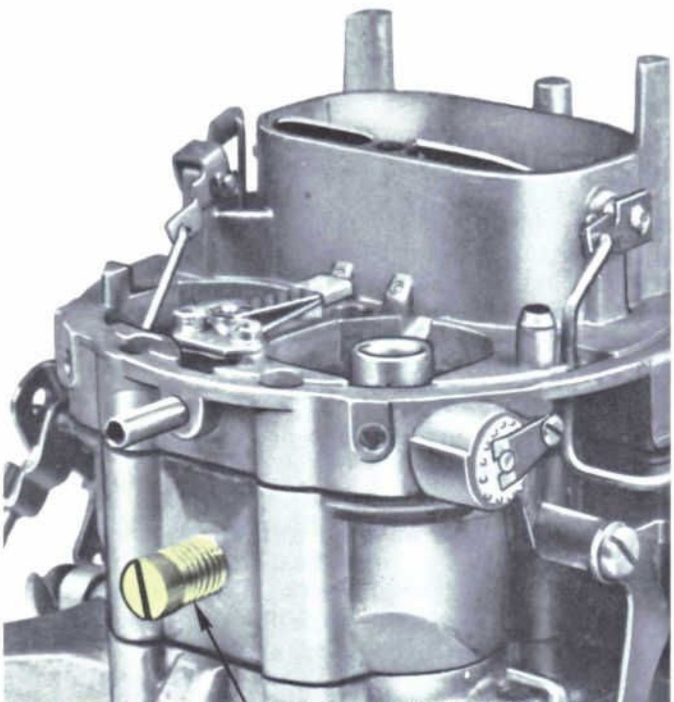


Fig. 27 — Idle Air Adjusting Screw — Autolite Model 4300 Carburetor for Thunderbird

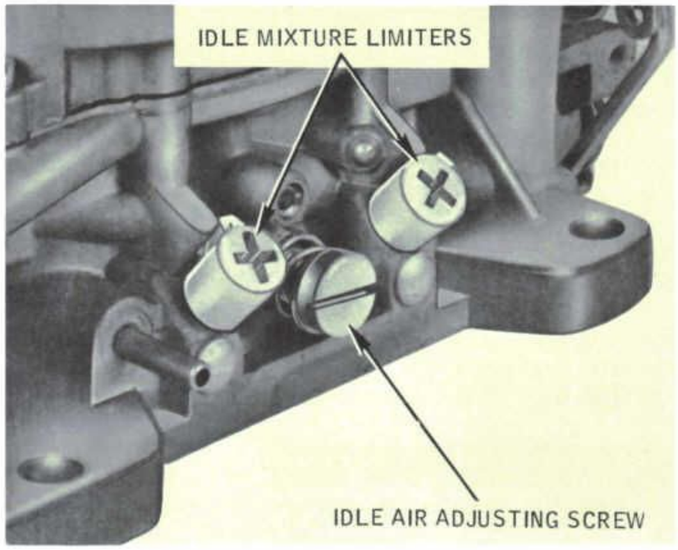


Fig. 28 — Idle Air Adjusting Screw — Carter 4-V Carburetor for Lincoln

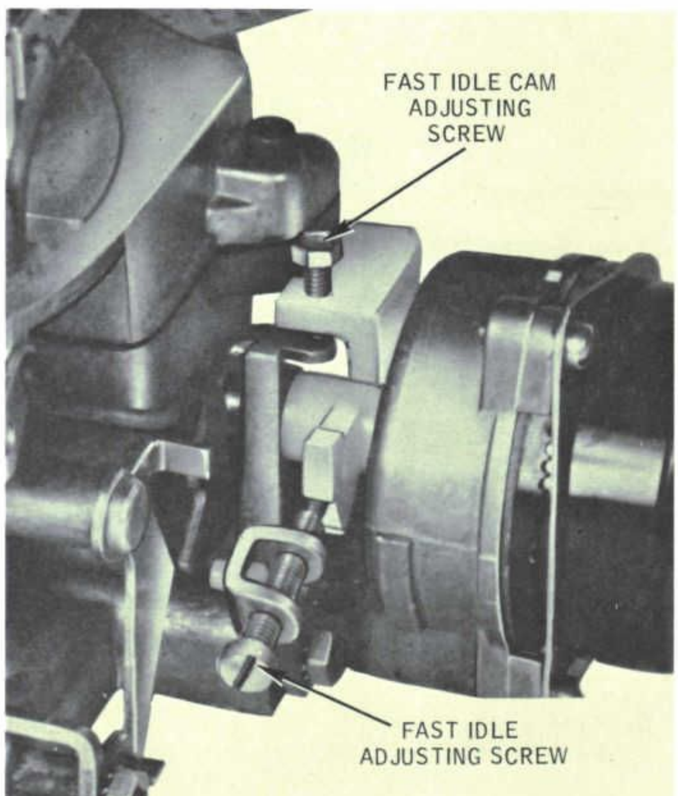


Fig. 29 — Fast Idle Cam Position for Engine Warm-Up

Normal Idle Fuel Settings — Engine On

1. The engine and underhood temperatures must be stabilized before idle adjustments are made. Therefore, operate the engine a minimum of 20 minutes at 1500 rpm. This can be done by positioning the fast idle screw on the intermediate step of the fast idle cam (Fig. 29).

2. Check the initial ignition timing and the distributor advance and retard.

Use an accurate reading tachometer when checking the initial ignition timing and idle fuel mixture and speed as outlined under "Initial Ignition Timing" in the Ignition System Section.

3. On manual-shift transmissions, the idle setting must be made only when the transmission is in Neutral.

On automatic transmissions, the idle setting is made with the transmission selector lever in the Drive range, except as noted when using an exhaust gas analyzer.

4. Be sure the choke plate is in the full-open position (Fig. 30).

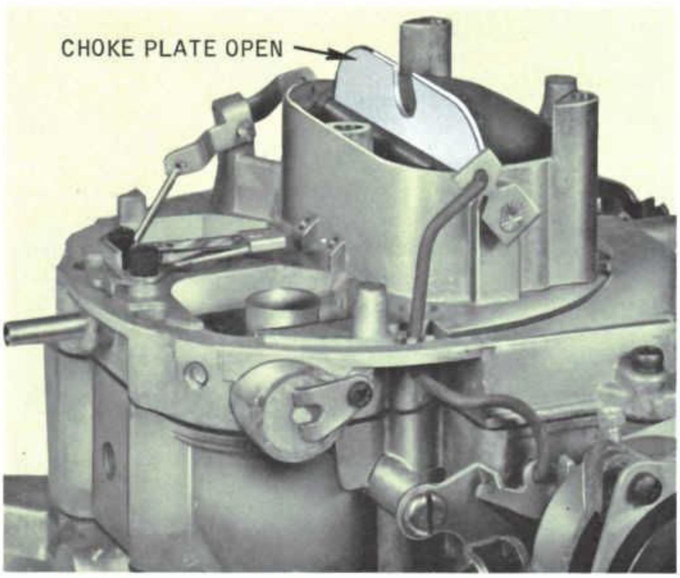


Fig. 30 — Choke Plate in Full-Open Position

5. On carburetors equipped with a hot idle compensator or where the idle compensator is in the crankcase ventilation hose, be sure the compensator is seated to allow for proper idle adjustment (Fig. 31).

6. Turn the headlights on high beam to place the alternator under a load condition in order to

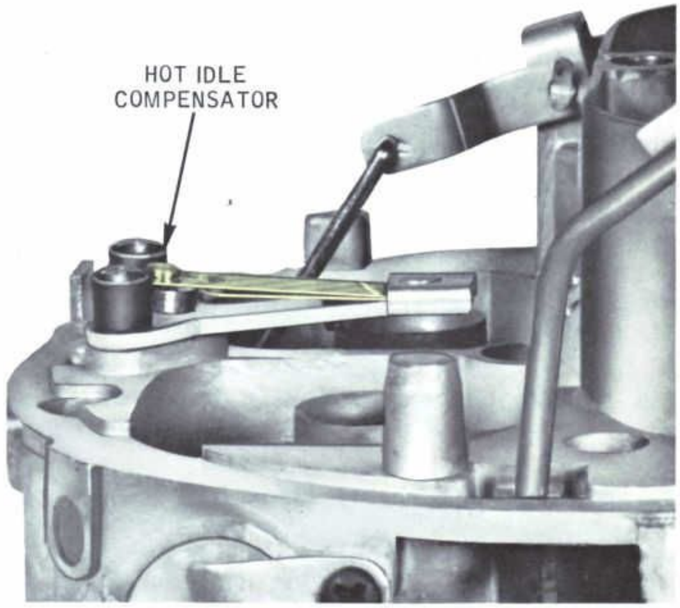


Fig. 31 — Hot Idle Compensator in Seated Position

properly adjust the specified engine idle speed during the adjustment procedure.

7. The final idle speed adjustment is made with the air conditioner turned ON (except on 200 6-cylinder and 302 2-V V-8 engines with automatic transmission, the air conditioner should be OFF).

8. Adjust the engine curb idle rpm to specifications. On the Thunderbird and Lincoln, readjust the idle air bypass screw, as required, to correct the idle speed. The tachometer reading (rpm) must be taken with the air cleaner installed. On vehicles with less than 50 miles, set the idle speed approximately 25 rpm below specifications to allow for an rpm increase as the engine "loosens up" in the first 100 miles of driving.

If it is not possible to adjust the idle speed with the air cleaner installed; remove it, make the adjustment, then replace the air cleaner and check again for the specified rpm.

9. Turn the idle mixture adjusting screw(s) inward to obtain the smoothest idle possible within the range of the idle limiter(s). On Autolite 2- and 4-venturi carburetors, turn the idle mixture adjusting screws inward an equal amount.

Check for idle smoothness only with the air cleaner installed.

10. After the final adjustment of the idle rpm and mixture, stop the engine and adjust the carburetor

fuel bowl vent valve (Fig. 32) to specifications (all but the Autolite Model 4100 4-V and Carter Model YF 1-V carburetors).

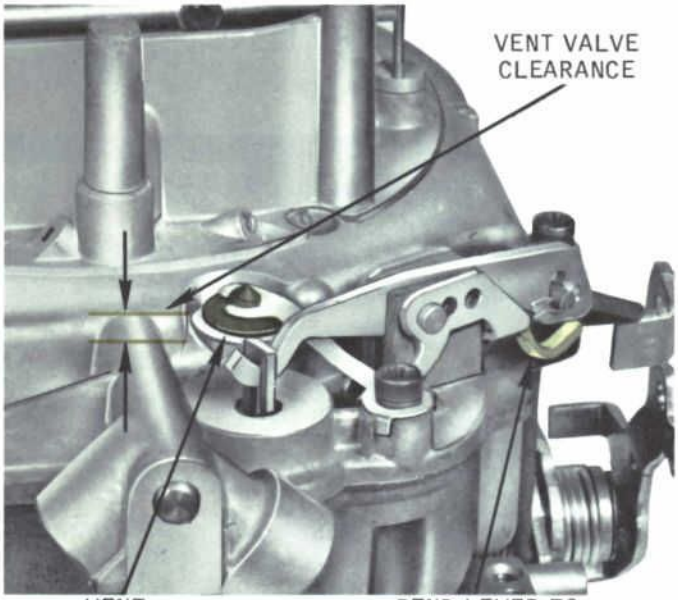


Fig. 32 — Fuel Bowl Vent Valve Adjustment — All Except Autolite Model 4100 4-V and Carter YF 1-V

Additional Idle Speed and Fuel Mixture Procedures

If a satisfactory idle condition is not obtained after performing the preceding normal idle fuel settings, additional checks of engine systems must be performed.

1. The following items should be checked and, if required, corrected:
   - Vacuum leaks
   - Ignition system wiring continuity
   - Spark plugs
   - Distributor breaker point dwell angle
   - Distributor point condition
   - Initial ignition timing

In certain instances, it may be possible that the idle condition is not as good as expected. It is suggested that the customer with a new vehicle be advised that the vehicle be driven 50 to 100 miles, and then, when the engine friction has been reduced, the idle condition should be improved. If, after this break-in period, the idle condition is believed to be unsatisfactory, readjust the engine idle speed to specification and observe for a satisfactory idle.

2. If the idle condition is not improved after the items in step 1 have been checked, perform the following engine mechanical checks:
   - Fuel level and fuel bowl vent
   - Crankcase ventilation system
   - Valve lash (mechanical tappets) and valve clearance, using the collapsed tappet method (hydraulic tappets)
   - Engine compression

3. After verification of all engine systems has been made, there may be isolated cases where a satisfactory idle condition has not been obtained due possibly to a lean idle fuel mixture. If this condition is encountered, check the air-fuel ratio with the aid of an exhaust gas analyzer, and adjust the air-fuel ratio to specifications.

USE OF THE EXHAUST GAS ANALYZER

The use of the exhaust gas analyzer (Fig. 33) is recommended only after the "Normal Fuel Setting Procedures" and "Additional Idle Speed and Fuel Mixture Procedures" have been performed and the engine idle condition is still not satisfactory.

1. Connect a Rotunda Model ARE 27-56U or 27-76 Exhaust Gas Analyzer, or equivalent A/C-powered unit, in accordance with instructions provided by the manufacturer. *All exhaust gas analyzers must be checked for proper calibration.* Rotunda analyzers must have a *Certified Calibration* identification on the face of the instrument.

2. On a Thermactor-equipped vehicle, disconnect the Thermactor pump air supply hose at the air pump or the check valve(s). Do not adjust for the drop in engine idle speed, which occurs when the air supply hose is disconnected. Note the amount of rpm drop for use in step 4.

3. Observe the reading obtained on the exhaust gas analyzer. *The analyzer reading must be taken with the air cleaner installed.* Refer to the specifications for the specified minimum air-fuel ratio.

4. Turn the idle mixture adjusting screw(s) as required within the range of the idle limiter until the specified air-fuel ratio is obtained (on 2-V and 4-V carburetors, turn the screws an equal amount). *The analyzer reading must be obtained with the air cleaner installed.* Correct for any changes in engine idle speed immediately as the idle mixture screw(s) are turned. (Refer to the

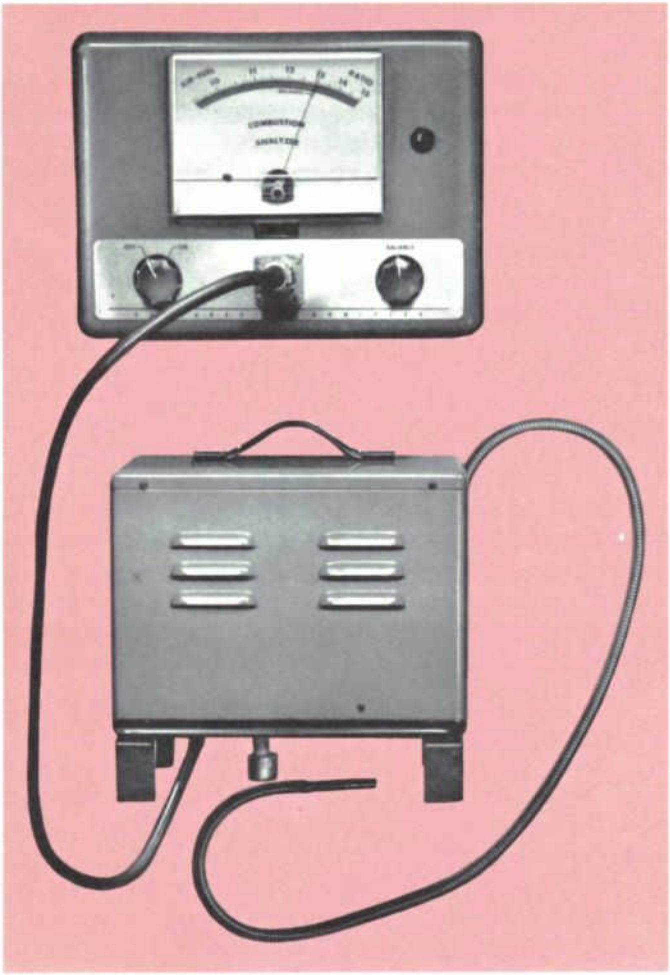


Fig. 33 — Rotunda Model ARE 27-76 Exhaust Gas Analyzer

drop in idle rpm obtained when the Thermactor air pump hose(s) were disconnected in step 2, then correct the idle speed to the rpm noted.) *Allow at least 10 seconds following each idle mixture screw adjustment for the analyzer reading to properly respond and stabilize.*

Verify the analyzer reading — Thermal conductivity exhaust gas analyzers will give an erroneously rich reading if the air-fuel mixture is *extremely* lean. To check for this condition, partially hand choke the carburetor, or rapidly open-and-close the throttle three or four times, to enrich the air-fuel mixture. The analyzer meter will reflect the momentary rich condition, then will deflect in the lean direction as the rich condition subsides, and will gradually return to a richer reading as the excessively lean air-fuel ratio is produced. *Vehicles with an automatic transmission must be in Neutral while this is being done.*

5. If the air-fuel ratio is to specifications, *and the various engine systems are functioning correctly,* no further adjustments should be made.

If the air-fuel ratio is not to specifications, as shown by the analyzer reading, it may be corrected by altering the controlled limits of the carburetor idle fuel system. Refer to the procedures in:

- *Removal and Installation of Idle Limiter Caps — All Autolite and 4-V Carter Carburetors*
- *Removal and Installation of Lead Seal and Readjustment of Idle Limiter — Carter 1-V Carburetor*
- *Enlarging Secondary Idle Discharge Ports — Holley 4-V Carburetor*

Removal and Installation of Idle Limiter Caps — All Autolite and 4-V Carter Carburetors

1. Remove the plastic limiter caps by cutting them with side-cutter pliers and a knife. After the cut is made, carefully pry the limiter apart. *On some carburetors, it may be necessary to remove the carburetor to remove the limiters.*
2. After the limiters are removed, set the carburetor to the correct air-fuel ratio, using the exhaust gas analyzer.
3. When the air-fuel ratio is within specifications, install a colored plastic service limiter cap.

When installing the limiter cap (Fig. 34), use care not to turn the idle mixture screw with the cap. Position the cap so that it is in the maximum counterclockwise position with the tab of the limiter against the stop on the carburetor.

The idle mixture adjusting screw will then be at the maximum allowable outward, or rich, setting.

To install the service limiter cap, use a straight, forward pushing force with thumb pressure or a 3/8-inch socket wrench extension.

4. Recheck the air-fuel ratio with the air cleaner installed, using the exhaust gas analyzer to make sure the limiter caps are properly installed.

Removal and Installation of the Lead Seal and Readjustment of the Idle Limiter — Carter 1-V Carburetor

1. Remove the lead seal covering the idle limiting needle in the throttle body (Fig. 35) by carefully picking it out with a sharp-pointed tool.

If necessary, drill out the center of the lead seal with a 1/8-inch diameter drill in a pin vise.

2. With the idle adjusting needle at the maximum rich setting, slowly back out the idle limiter, 1/16 turn at a time, until the specified air-fuel reading is obtained on the exhaust gas analyzer.

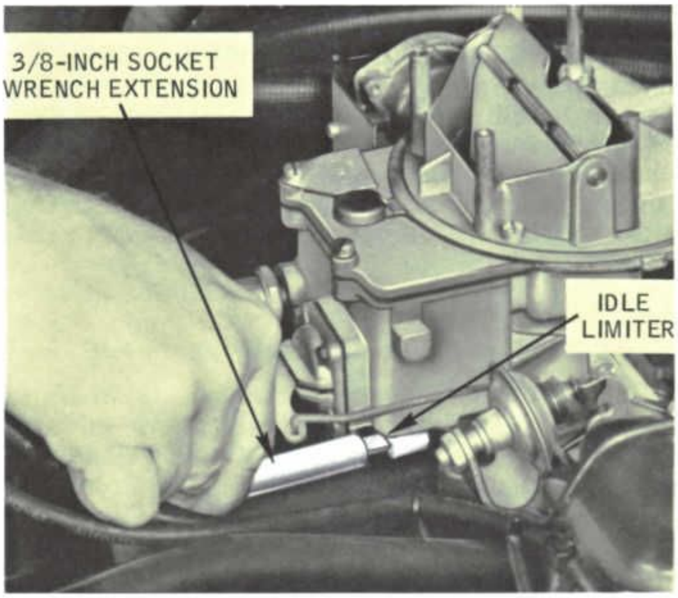


Fig. 34 — Idle Limiter Installation — Autolite Carburetors

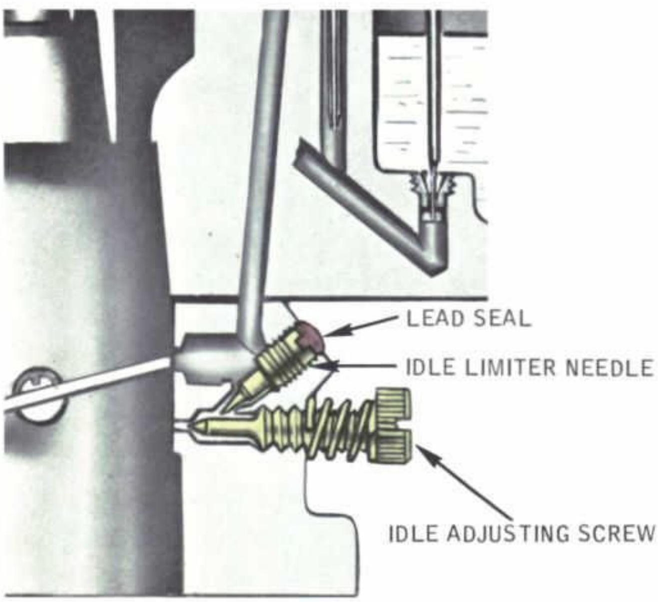


Fig. 35 — Idle Limiter, Seal and Idle Adjusting Screw — Carter 1-V Carburetor

3. After obtaining the specified air-fuel reading, install a new lead seal over the idle limiter. Drive the lead seal into the hole with a small punch until the lead just contacts the head of the screw. After the idle limiter has been reset and the air-fuel ratio and idle condition are satisfactory, stamp or scribe the letter "R" on the carburetor identification tag just above the name Autolite to indicate the carburetor has been reworked.

Enlarging the Secondary Idle Discharge Ports — Holley 4-V Carburetor

This enrichment alteration should be performed only after it has been firmly established that the rough idle is caused by a lean condition as indicated on an exhaust gas analyzer.

1. Remove the carburetor.

2. Enlarge the secondary idle discharge ports with a No. 70 (0.028-inch diameter) drill in a pin vise (Fig. 36). Coat the drill bit with grease and slowly rotate the drill through the port. *Do not enlarge the ports beyond the specified drill size. After removing the drill, make sure all of the metal chips are removed.*

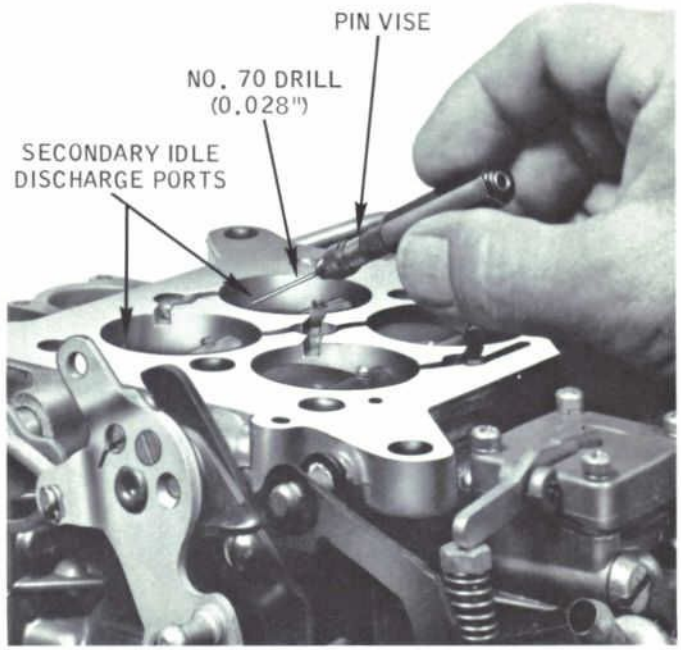


Fig. 36 — Secondary Idle Discharge Ports Enlargement — Holley 4-V Carburetor

3. Install the carburetor and adjust the speed and mixture to the specified rpm and air-fuel

ratio, using a tachometer and exhaust gas analyzer. After the secondary idle discharge ports have been enlarged and the air-fuel ratio and idle condition are satisfactory, mark the carburetor identification tag with the letter "R." Use a metal stamp and mark the tag above the name Autolite.

IGNITION SYSTEM

DESCRIPTION AND OPERATION

The 1968 engine ignition systems are basically the same as in past model years, but some new features have been incorporated. Improvements to the distributor timing advance and retard mechanisms, in combination with the leaner carburetor air-fuel ratios, provide for the required reduction in exhaust gas contaminants on IMCO equipped engines. Thermactor equipped engines employ additional means of exhaust emission control.

New features in the ignition system are:

- Dual-diaphragm vacuum advance distributor
- Distributor vacuum control valve (temperature sensing)
- Distributor vacuum advance control valve (deceleration)
- Vacuum sources for distributor vacuum advance units

All distributors are equipped with both vacuum and centrifugal advance units. The vacuum advance governs the ignition timing (spark advance) during low engine speeds (rpm) or low engine loadings. The centrifugal advance, in combination with the vacuum advance, controls the ignition timing at higher engine speeds or heavy engine loadings to provide the correct ignition timing for maximum engine performance. A dual-diaphragm vacuum advance is used on some engines to provide additional ignition timing retard during engine operation.

Dual Advance Distributor — Single-Diaphragm Vacuum Advance

The distributor has two independently operated spark advance systems. A centrifugal advance mechanism (Fig. 37), located below the stationary sub-plate assembly, has centrifugal weights that move inward or outward with changes in engine speed. As engine speed increases, the centrifugal weights cause the cam to advance or move ahead

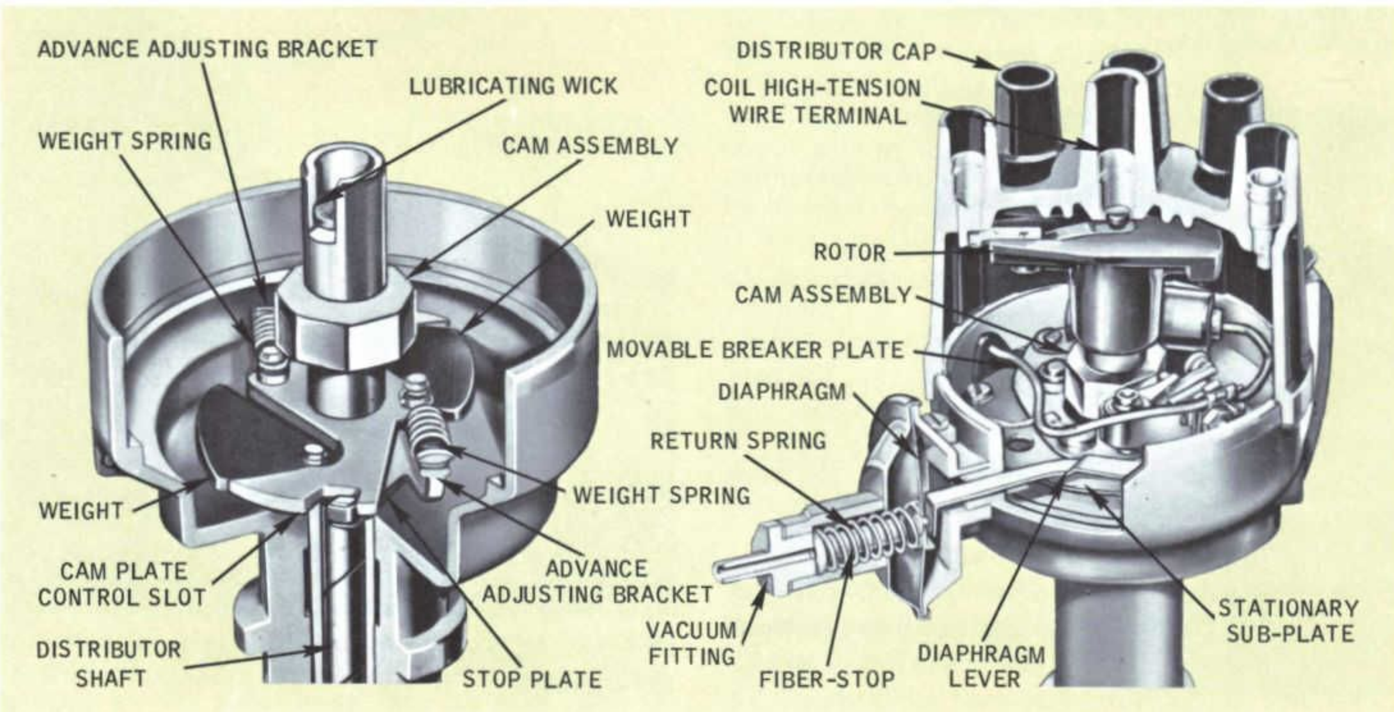


Fig. 37— Advance Mechanisms — Dual Advance Distributor with Single Vacuum Diaphragm

with respect to the distributor drive shaft. The rate of advance is controlled by calibrated weight springs.

The vacuum advance has a spring-loaded diaphragm connected to the breaker plate assembly. The diaphragm is actuated against the spring pressure by vacuum pressures. When the vacuum increases, the diaphragm causes the movable breaker plate to pivot on the stationary subplate. The breaker point rubbing block, which is positioned on the opposite side of the cam from the pivot pin, then moves opposite to distributor rotation and advances the spark timing. As the movable breaker plate is rotated from retard position to full-advance position, the breaker point dwell decreases slightly. This is caused by the breaker point rubbing block and the cam rotating on different axes.

Dual-Diaphragm Vacuum Advance Distributor

On dual-diaphragm vacuum advance distributors (Fig. 38), the centrifugal advance unit is the same as on single-diaphragm vacuum advance distributors. The dual-diaphragm unit consists of two independently operating diaphragms (Fig. 38). The advance (primary) diaphragm utilizes carburetor vacuum to advance ignition timing. The retard (secondary) dia-

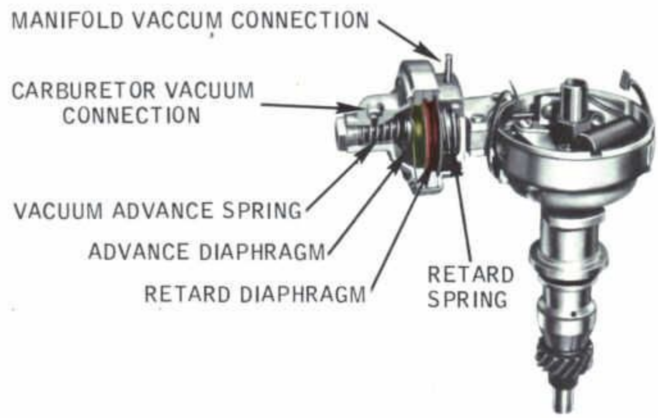


Fig. 38 — Dual-Diaphragm Vacuum Advance Distributor

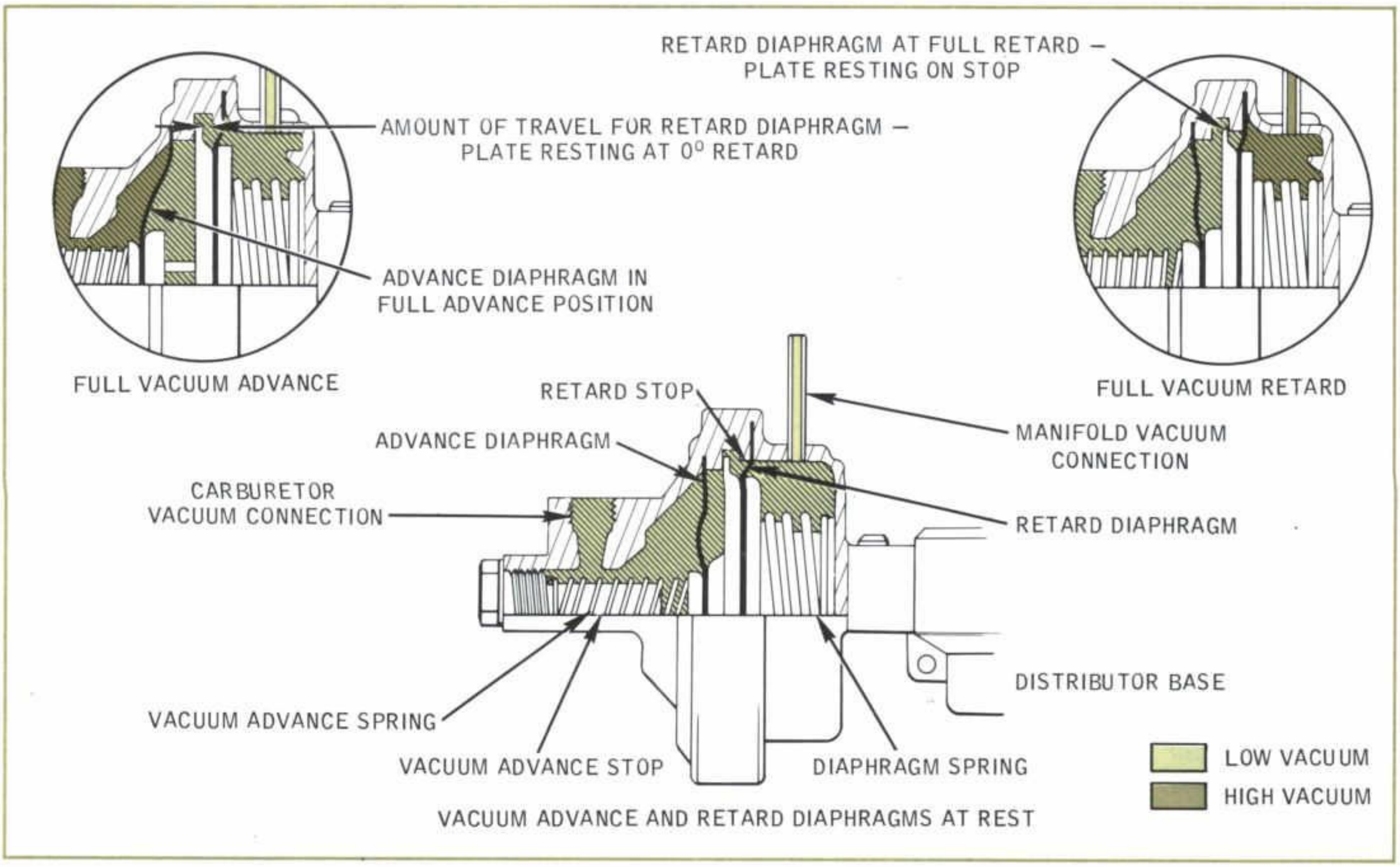


Fig. 39 — Dual-Diaphram Vacuum Advance Mechanism

phragm is actuated by intake manifold vacuum to provide additional ignition timing retard during periods of closed throttle deceleration and idle, thereby assisting in the reduction of exhaust system hydrocarbons.

The advance diaphragm (outer) is coupled to the movable breaker plate much the same way as in single-diaphragm distributors. An increase in vacuum pressure moves the diaphragm against the advance diaphragm spring tension, causing the movable breaker plate to pivot opposite to distributor rotation (Fig. 39). Thus, ignition timing is advanced, and this advance is calibrated to occur during normal road-load operation, but not during deceleration or idle.

When intake manifold vacuum is applied to the retard diaphragm (inner), it moves in toward the distributor (Fig. 39). This allows the advance diaphragm spring to move the advance diaphragm, causing the movable breaker plate to pivot in the same direction as distributor rotation. This retard of the ignition timing occurs during engine idle or deceleration.

Distributor Vacuum Control Valve

The distributor vacuum control valve (temperature-sensing valve), illustrated in Fig. 40, is incorporated in the distributor vacuum advance supply line to provide advanced ignition timing under certain engine operating conditions. The distributor vacuum control valve is installed in the coolant outlet housing to sense engine coolant temperatures. Normally, the valve connects two ports: normal source vacuum at the carburetor and the distributor port. During periods of prolonged idle, should the engine temperature rise above normal, the valve closes the normal source vacuum port and connects the distributor port to the alternate source (intake manifold) vacuum port. On some engines, the latter port is capped with a filter, thus sensing ambient pressures. The advanced ignition timing causes an immediate increase in engine speed which will continue until the engine temperature returns to normal. The distributor vacuum system schematics for the various engine systems are illustrated in the last section of this handbook.

Distributor Vacuum Advance Control Valve

On the 170 and 240 six-cylinder engines and Bronco 289 V-8, a distributor vacuum advance control valve (deceleration valve) is incorporated in the distributor vacuum system to provide additional control of the ignition timing (Fig. 41). This device is used in conjunction with the dual-diaphragm vacuum advance unit. Normally, the advance diaphragm (outer) is connected to a vacuum port on the carburetor. During deceleration periods when intake manifold vacuum rises above a specific value, the deceleration valve closes off the carburetor vacuum and provides direct intake manifold vacuum to the distributor advance diaphragm (outer). This permits maximum ignition timing advance to prevent "afterburning" or "popping" in the engine exhaust system. When the vehicle slows down and the engine is operating at idle, the deceleration valve shuts off the intake manifold vacuum and opens the carburetor vacuum to the distributor.

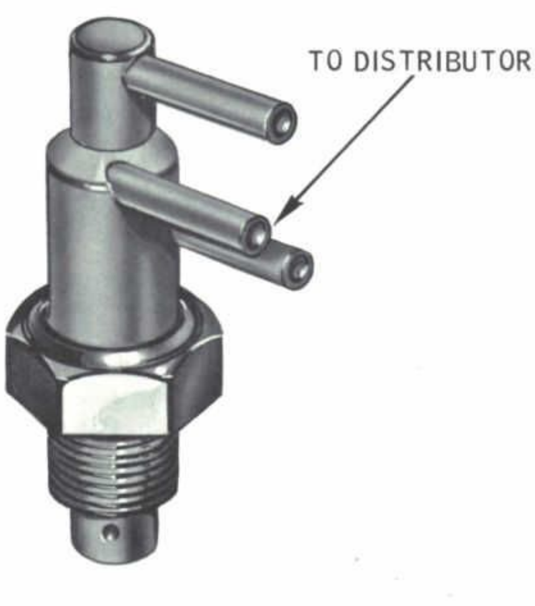


Fig. 40 — Distributor Vacuum Control Valve

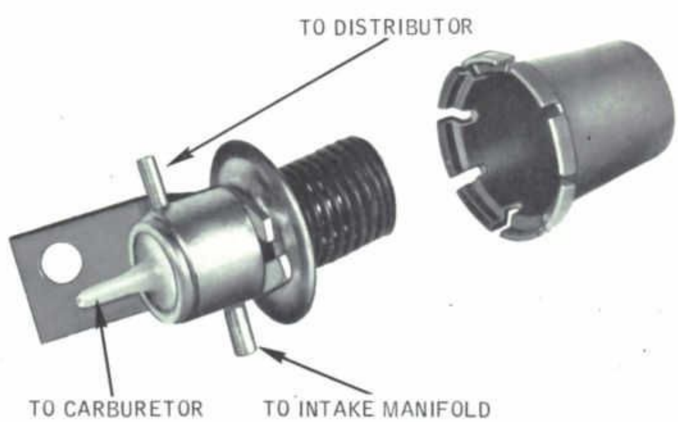


Fig. 41 — Distributor Vacuum Advance Control Valve

DIAGNOSIS AND TESTS

Refer to the applicable shop manual for diagnosis of the ignition system primary and secondary system problems. To isolate engine problems to the distributor vacuum system, refer to the "Vehicle Emission Control Systems Diagnosis Guide."

To test the ignition electrical system, use an oscilloscope, following the procedures in the applicable shop manual. To check the distributor advance vacuum system, be sure the vacuum lines are properly connected as shown in the schematics in the last section of this handbook. Verify the complaint or symptom; then check the operation of the distributor vacuum control valve, vacuum advance control valve, and dual-diaphragm vacuum advance (if so equipped).

Distributor Vacuum Control Valve Test

1. Make certain that all vacuum hoses are properly routed and installed.
2. Attach a tachometer to the engine.
3. Bring the engine up to operating temperature and be certain that the choke plate is in the vertical position. *The engine must not be overheated.*
4. Note the engine idle rpm with the transmission in Neutral and the carburetor throttle in the curb idle position.
5. Disconnect the vacuum hose from the intake manifold at the temperature-sensing valve and plug or clamp the hose.
6. Note the engine idle rpm with the hose disconnected. If there is no change in idle speed, the valve is acceptable up to this point. If there is a drop in idle speed of 100 rpm or more, the valve should be replaced.
7. Verify that the all-season cooling mixture is up to specifications, and that the correct radiator cap is installed.
8. Cover the radiator sufficiently to induce a high-temperature condition.
9. Continue to operate the engine until the red (high-temperature) light comes on indicating an above normal temperature.

If the engine idle speed has by this time increased 100 rpm or more, the temperature-sensing valve is satisfactory. If not, it should be replaced. *Do not permit engine to operate in an overheated condition any longer than is necessary to determine that the valve is good or bad.*

Distributor Vacuum Advance Control Valve Test

1. Connect a tachometer to the engine, and operate the engine until normal operating temperature is reached.
2. Connect a vacuum gauge to the distributor vacuum line. Be sure the tee has approximately the same inside diameter as the distributor vacuum line to prevent false pressure readings.
3. If the engine is equipped with a dashpot, tape the plunger in a depressed position so that it does not contact the throttle lever at idle speed.
4. Use a clamp to close the vacuum line that connects the deceleration valve to the intake manifold.
5. Remove the distributor vacuum hose at the distributor and clamp the hose closed.
6. With engine operating at specified idle rpm (transmission in Neutral and parking brake on), set the ignition timing to specifications.
7. If necessary, adjust the carburetor to the specified engine speed and air-fuel ratio. The distributor vacuum must be below six inches of mercury at idle speed.
8. Remove the clamps from the vacuum tubes and reconnect the vacuum line to the distributor. Remove the distributor vacuum advance control valve cover as shown in Fig. 42.

Fig. 42 — Distributor Vacuum Advance Control Valve Adjustment

9. Increase engine speed to 2000 rpm in Neutral and hold the speed approximately five seconds. Release the throttle and note the distributor vacuum reading. When the throttle is released, the distributor vacuum should increase to more than 16 inches of mercury and remain there for a

minimum of one second. The distributor vacuum should fall below six inches of mercury within three seconds after the throttle is released.

10. It is normal during this period for a buzzing sound to be heard. If it takes less than one second or more than three seconds for the distributor vacuum to fall below six inches of mercury, adjust the valve. Turning the spring end adjusting screw (Fig. 42) counterclockwise will increase the time that the distributor vacuum remains above six inches of mercury after the throttle is closed. One turn of the adjusting screw will change the valve setting by approximately one-half inch of mercury. If the valve cannot be adjusted to specifications, replace the valve.

11. Replace the valve cover. Remove the tape from the dashpot plunger, and recheck the performance of the deceleration valve. If the distributor vacuum does not fall below six inches of mercury within four seconds after the throttle is closed, adjust the dashpot to specifications or replace it.

12. To check the distributor vacuum advance control valve for a possible diaphragm leak, connect a vacuum gauge into the vacuum hose connecting the valve to the intake manifold vacuum connection. Use a tee fitting with the same diameter as the inside diameter of the vacuum hose (1/4-inch I.D.). Clamp the vacuum hose connecting the valve to the distributor. Clamp the hose connection between the valve and carburetor.

Start the engine and operate it at normal idle speed. Note the vacuum reading. Place a clamp on the vacuum hose connecting the valve to the intake manifold (between the valve and the vacuum gauge tee). Note the vacuum reading. If the second reading indicates a higher vacuum than the first, replace the deceleration valve.

Dual-Diaphragm Vacuum Advance and Vacuum Retard Functional Check

1. To check the vacuum advance, disconnect the vacuum lines from both the advance (outer) and retard (inner) diaphragms. Plug the line removed from the retard diaphragm.

Install a tachometer and timing light on the engine. Increase the engine idle speed by setting the screw on the first step of the fast idle cam. Note the ignition timing setting.

Connect the carburetor vacuum line to the advance diaphragm. If the timing advances immediately, the advance unit is operating properly.

Adjust the engine idle speed to 550-600 rpm.

Check the vacuum retard as follows:

2. Using a timing light, observe the ignition timing with the engine operating at normal idle speed.

Remove the plug from the manifold vacuum line and connect the line to the inner diaphragm. The ignition timing should retard immediately.

3. If the vacuum retard is not to specification, replace the dual-diaphragm advance unit. If the advance (vacuum) does not operate properly, calibrate it on a distributor test stand, following the procedures for dual advance distributors in the applicable shop manual. If the advance part of the unit cannot be calibrated, or if either diaphragm is leaking, replace the dual-diaphragm vacuum advance unit.

Diaphragm Leak Test — Dual-Diaphragm Distributors

To check the diaphragm for leakage, install the distributor on a distributor tester.

Do not connect the vacuum line to the distributor. Adjust the vacuum pressure of a distributor tester to its maximum position. Hold your hand over the end of the tester's vacuum hose and note the maximum reading obtained. *Do not exceed 25 inches Hg.*

If the maximum reading is 25 inches Hg or less, connect the tester's vacuum line to the vacuum fitting on the advance diaphragm *without changing any of the adjustments.* The maximum gauge reading should not be less than it was above. If it is less, the diaphragm is leaking and should be replaced.

Repeat the above procedure with the vacuum line connected to the retard diaphragm to check for leakage.

ADJUSTMENTS

The procedure for setting the ignition timing includes functional checks for the advance and retard positions of the diaphragm assembly.

Initial Ignition Timing

1. Clean and mark the timing marks. Be sure the distributor vacuum lines are properly connected as illustrated in the schematics in the last section of this handbook.

2. Disconnect the vacuum line (single-diaphragm distributors) or vacuum lines (dual-diaphragm distributor), and plug the disconnected vacuum line(s).

3. Connect a timing light to the No. 1 cylinder spark plug wire. Install an engine speed tachometer.

4. Start the engine and adjust the initial ignition timing to specifications by rotating the distributor in the proper direction.

5. Check the mechanical (centrifugal) advance for proper operation. Start the engine and accelerate it to approximately 2000 rpm. If the ignition timing advances, the centrifugal advance mechanism is functioning properly. Note the engine speed when the advance begins and the amount of advance. Stop the engine.

6. Unplug the carburetor source vacuum line and connect it to the distributor vacuum advance unit (outer diaphragm on dual-diaphragm distributors). Start the engine and accelerate it to approximately 2000 rpm. Note the engine speed when the advance begins and the amount of advance. Advance of the ignition timing should begin sooner and advance farther than when checking the mechanical (centrifugal) advance alone. Stop the engine.

7. Check the vacuum retard operation on dual-diaphragm distributors. Connect the intake manifold vacuum line to the retard diaphragm side of the vacuum advance. Operate the engine at normal idle speed. The initial timing should retard to approximately TC if the initial ignition timing is correct. On some engines it will go as low as 6° ATC.

8. If the vacuum advance or vacuum retard (dual-diaphragm distributors) is not functioning properly (refer to steps 6 and 7 above), remove the distributor and check it on a distributor tester. Replace the dual-diaphragm unit if the vacuum advance portion cannot be calibrated, the retard portion is not to specification, or either diaphragm is leaking.

9. Unplug the vacuum line(s) and connect it to the distributor vacuum advance assembly. Remove the timing light and tachometer.

VEHICLE EMISSION CONTROL SYSTEMS DIAGNOSIS GUIDE

The following diagnosis procedures should be performed after it is determined that there is a malfunction related to the emission control system. Verify the customer complaint in all cases, either by means of diagnosis equipment or a road test.

ROUGH ENGINE IDLE

Operate the engine at idle speed and normal operating temperature. Observe if the engine idle is rough.

Fuel System

- Leaking vacuum line connections, hoses disconnected or missing caps.
- Engine idle speed set too low.
- Idle fuel mixture needle(s) not properly adjusted.
- Air leaks between the carburetor, spacer, and the manifold and/or fittings.
- Intake manifold gasket leak (V-8).
- Power valve leaking fuel.
- Idle fuel system air bleeds or fuel passages restricted.
- Secondary throttle plate(s) not closing (4-V carburetor).
- Improper secondary throttle plate stop adjustment (4-V carburetor).
- Float setting incorrect.
- Hot and cold air intake system stuck in "Heat-On" position.

Ignition System

- Improperly adjusted or defective breaker points.
- Fouled or improperly adjusted spark plugs.
- Incorrect ignition timing.
- High secondary wiring resistance.
- Secondary wiring connections loose or connected wrong.

Exhaust System

- Exhaust control valve inoperative or sticking (if so equipped).

Engine

- Leaking vacuum line connections, hoses disconnected or missing caps.
- Leaking intake manifold gasket.
- Loose engine mounting bolts or worn engine support insulators.
- Cylinder head bolts not properly torqued.
- Crankcase ventilation regulator valve defective or a restricted vent tube.
- Valve clearance set too tight.

- Worn camshaft lobes.
- Leaking intake or exhaust valves.

Perform a manifold vacuum or compression test to determine which mechanical component is at fault.

ENGINE OVERHEATS AT IDLE SPEED

With the engine operating, check the engine temperature gauge (or warning light) for indications of overheating. Determine if the condition is constant, intermittent or occasional. The latter could be caused by driving conditions.

Make sure the distributor vacuum control lines are properly connected. (Refer to the distributor vacuum system schematics at the last section of this handbook.)

ENGINE STARTS, BUT FAILS TO KEEP OPERATING

- Verify that the engine starts but fails to keep operating.
- Check for vacuum leaks, disconnected hoses and missing caps.

Fuel System

- Engine hot idle speed set too low.
- Idle fuel mixture needle(s) not properly adjusted.
- Engine fast idle speed set too low.
- The choke not operating properly.
- Choke thermostatic spring housing improperly adjusted.
- Choke pulldown clearance not adjusted to specification.
- Float setting incorrect.
- Fuel inlet system not operating properly.
- Dirt or water in the fuel lines, fuel filter, or carburetor.
- Fuel pump defective.
- Plugged fuel tank vent.
- Carburetor icing.

Ignition System

- Defective spark plugs.
- Breaker points improperly adjusted, or burned or pitted.
- Leakage in the high-tension wiring.
- Open circuit in the primary resistance wire.

DELAYED DECELERATION – COAST-DOWN

- Check anti-stall dashpot for specified clearance.

NOISY ENGINE

- Check for vacuum leaks, disconnect hoses or missing caps.

Noisy Thermactor Air Pump

The Thermactor air pump like any engine driven accessory may produce a detectable sound with the hood raised. This sound level, however, is not noticeable in the passenger compartment.

On occasion, a new air pump *may* produce a slight squealing sound on initial operation until the lip of the pump seal on the centrifugal filter fan wears in, and the pump vanes *may* produce intermittent chirping, squeaking, or knocking sounds at low engine speeds until the pump wears in. Although factory break-in should have eliminated these sounds, some mileage (30 miles or more) may be required on new vehicles to provide adequate air pump break-in.

If air pump sounds are considered objectionable, check the following:

- Drive belt improperly adjusted or drive pulley misaligned.
- Loose mounting bracket.
- Hoses disconnected or leaking.
- Hoses making contact with body parts.
- Defective centrifugal filter fan.
- Defective relief valve.
- Improper pressure—setting plug, broken spring, or plug missing.

Then, if it is determined that noise is coming from the air pump, and if the noise is diagnosed as a pump problem, the pump should be replaced.

Thermactor Air Pump Inoperative

- Remove air pump outlet hose to check for air delivery.
- Drive belt slipping over pump pulley indicates pump seizure.
- Adjusting arm to air pump bolt too long (7/8 inch maximum length).

Ignition

- Incorrect ignition initial timing (spark ping or knock).

Ignition — Continued

- Incorrect distributor advance (spark ping or knock).
- Low octane fuel.

Engine Mechanical

- Leaking intake manifold gasket.
- Loose engine mounting bolts or worn engine support insulator.
- Cylinder head bolts not properly torqued.
- Crankcase ventilation regulator valve defective or a restricted vent tube.
- Improper valve clearance.
- Worn camshaft lobes.

Perform a manifold vacuum or compression test to determine which mechanical component is at fault.

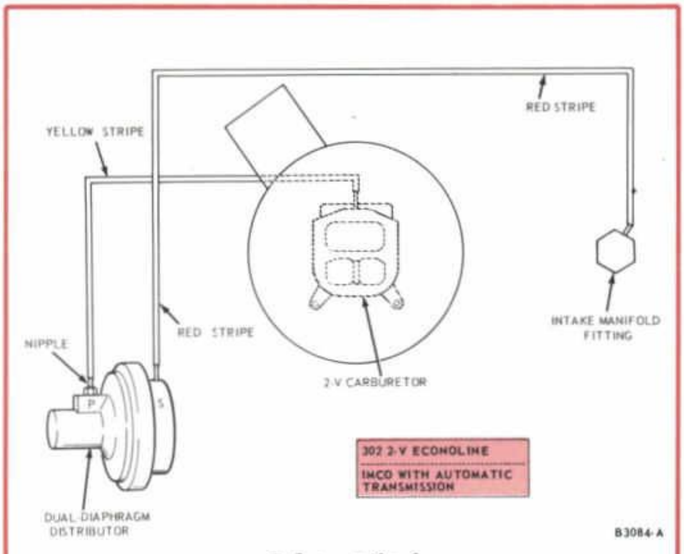
Exhaust System

- Air bypass valve vacuum line collapsed, plugged, disconnected or leaking, causing backfire.
- Defective or malfunctioning air bypass valve, causing backfire.
- Defective or malfunctioning distributor vacuum advance control valve, causing backfire.
- Exhaust system leak; exhaust manifold-to-cylinder head, muffler inlet pipe flange gasket, or muffler connections loose.

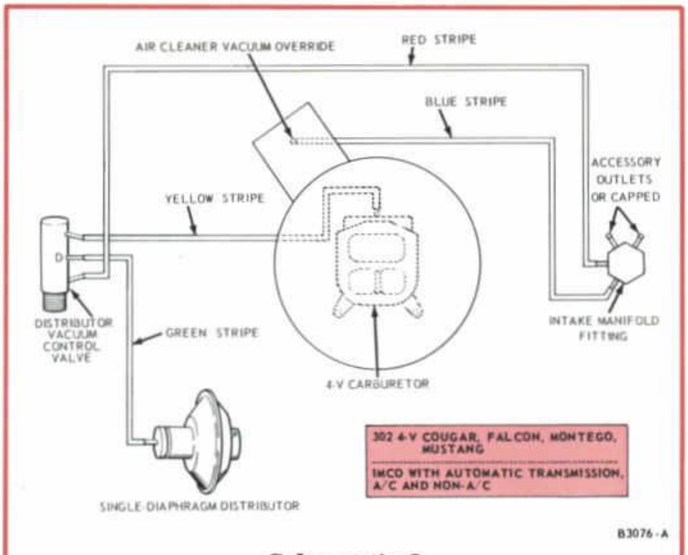
DISTRIBUTOR VACUUM SYSTEM SCHEMATICS

INDEX

INDEX--Continued



Schematic 1



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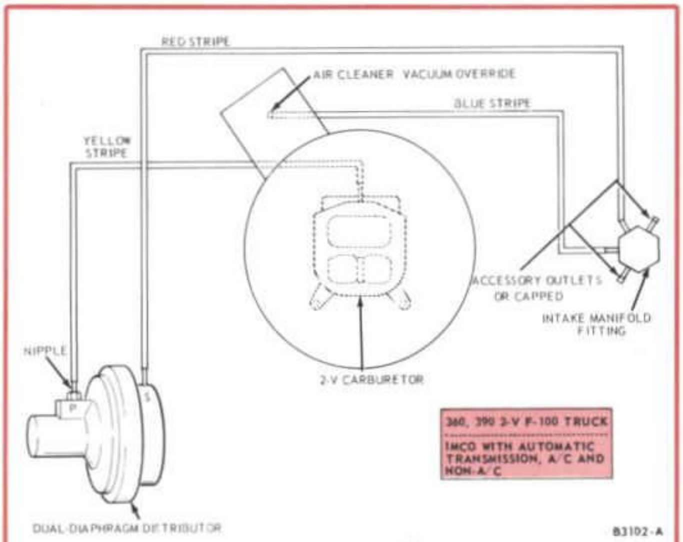

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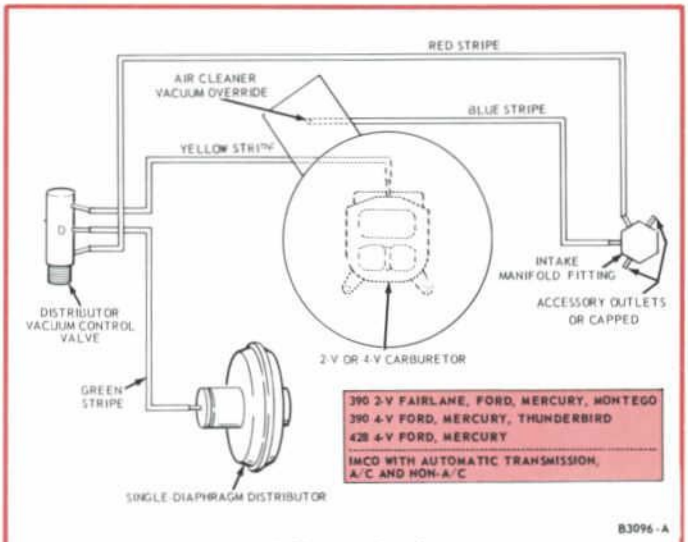

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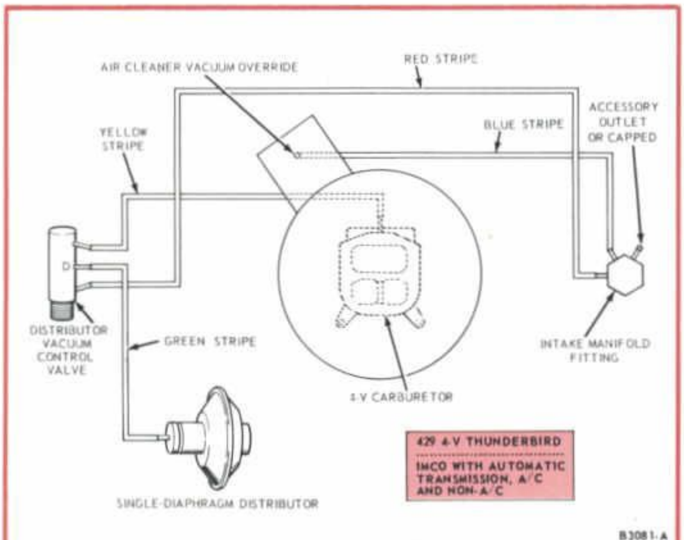

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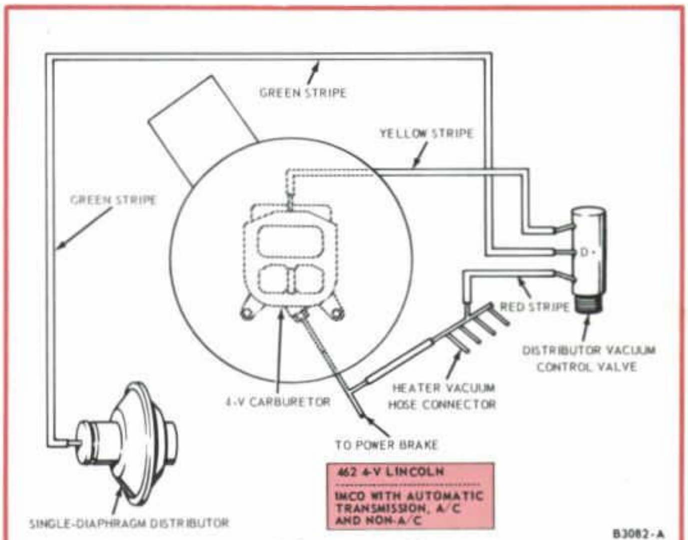
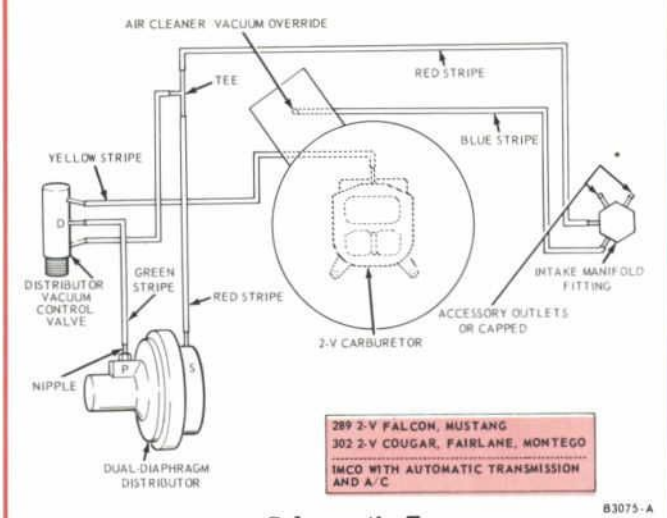


Schematic 6

DISTRIBUTOR VACUUM SYSTEM SCHEMATICS



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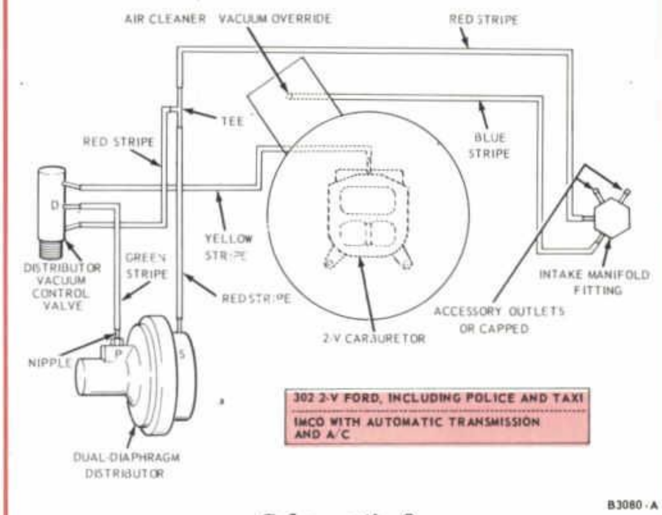

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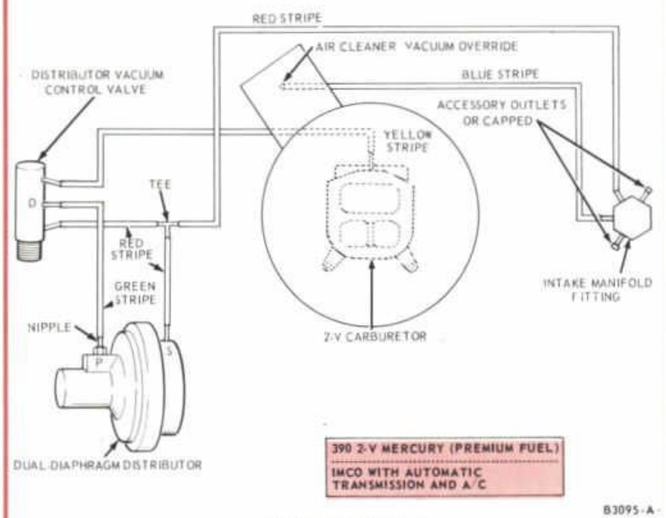

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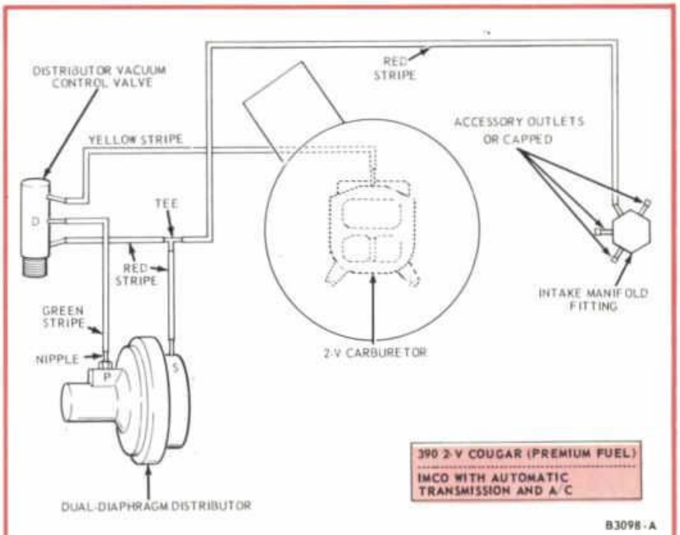

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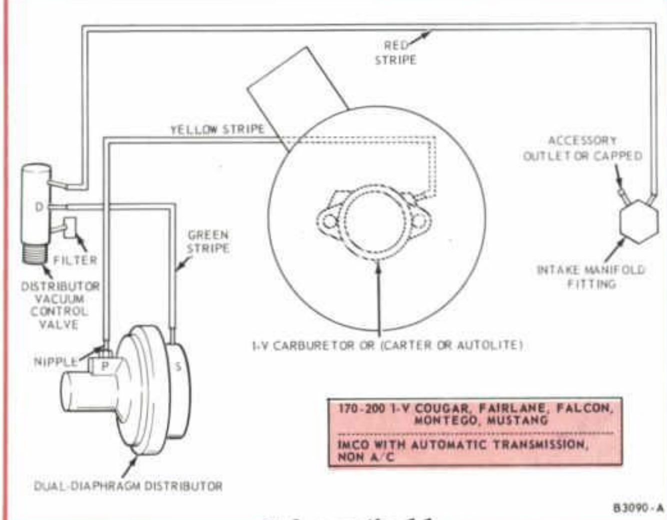

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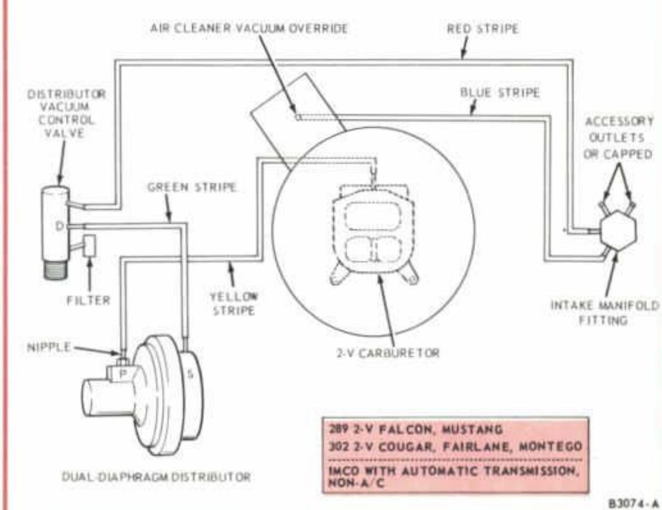
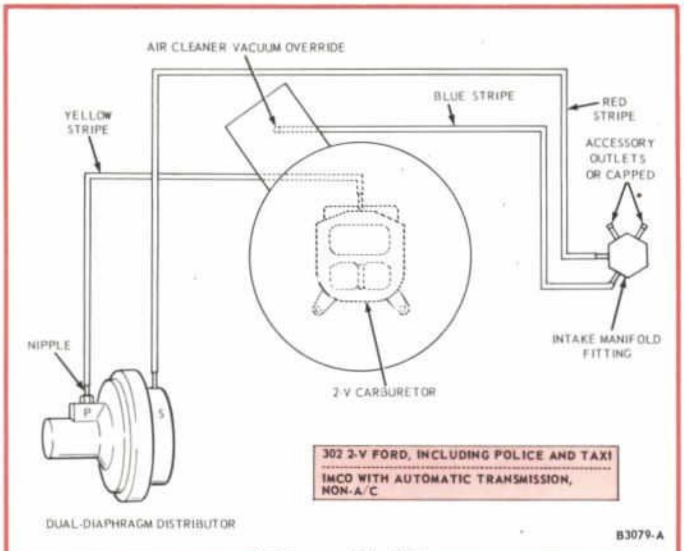


Schematic 12

DISTRIBUTOR VACUUM SYSTEM SCHEMATICS



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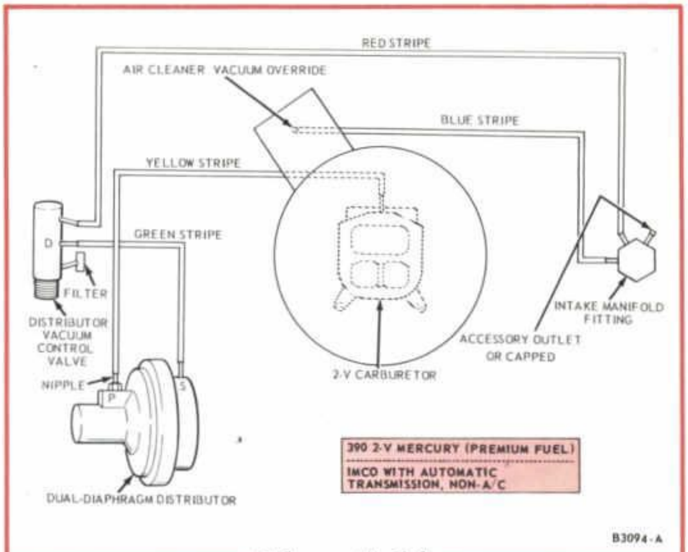

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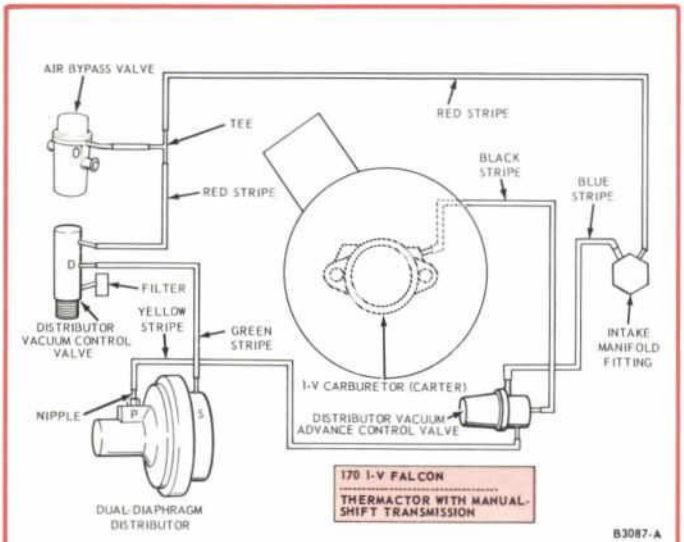

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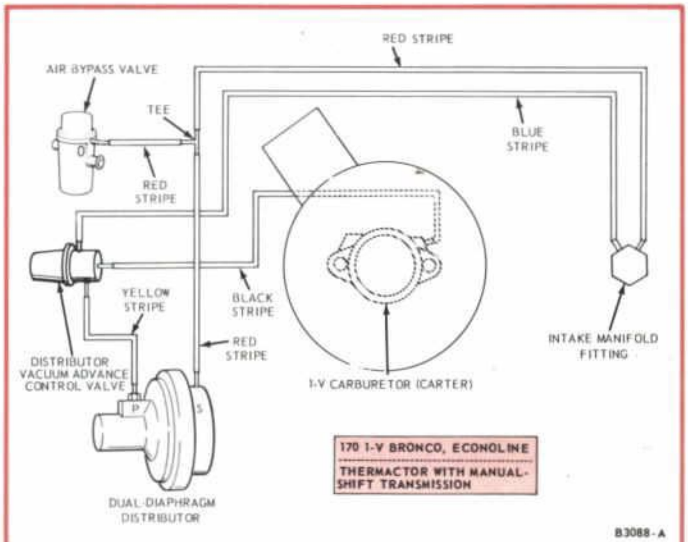

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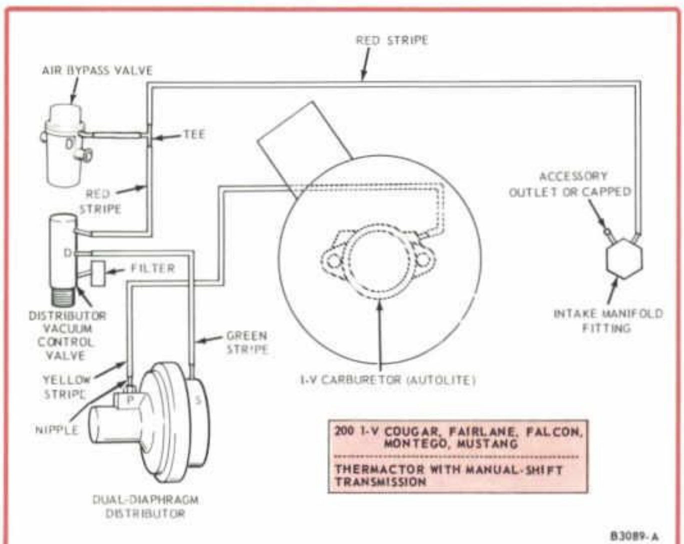
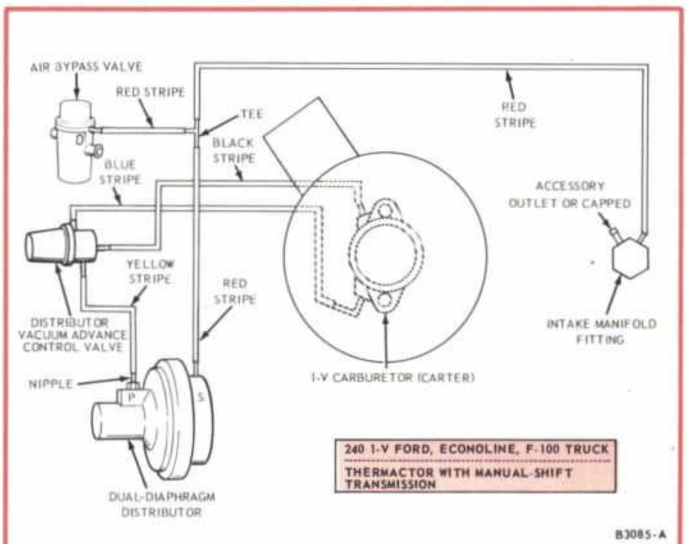


Schematic 17



Schematic 18

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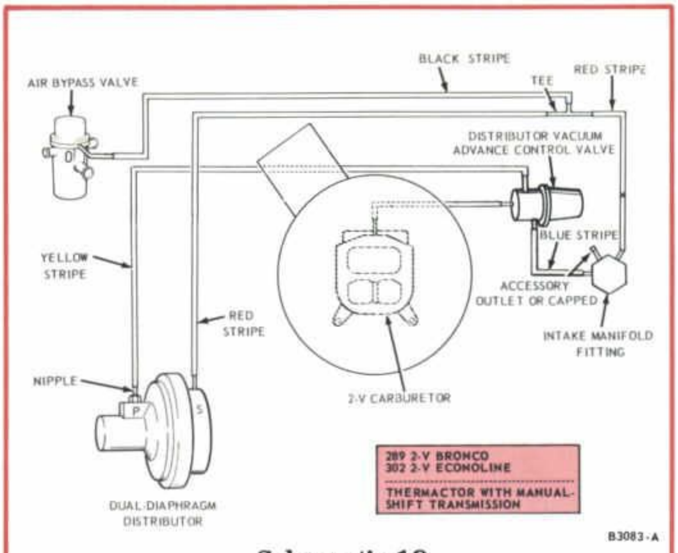

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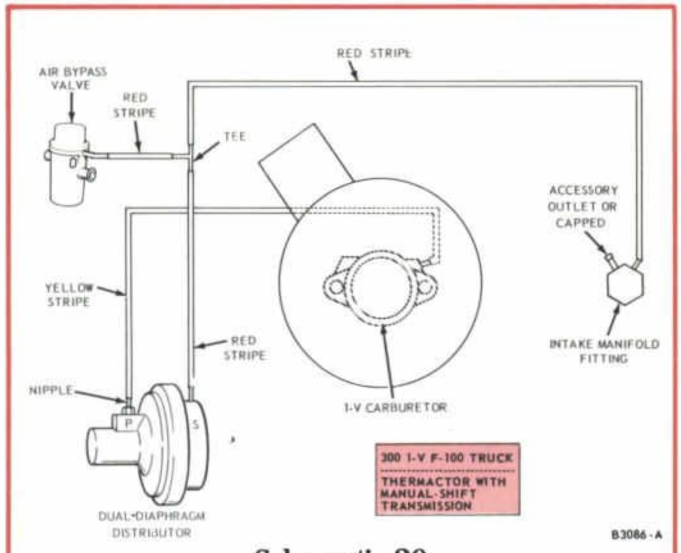

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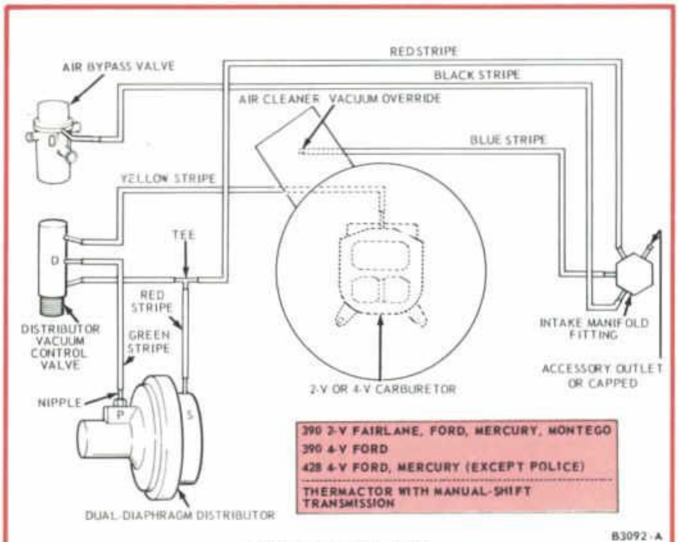

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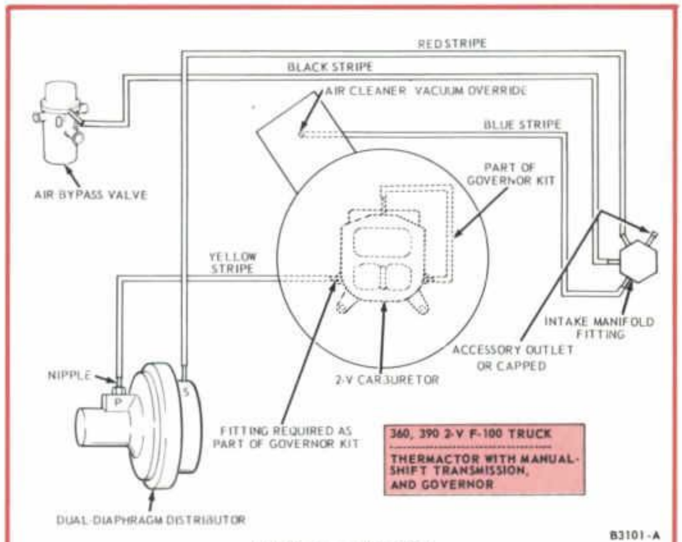

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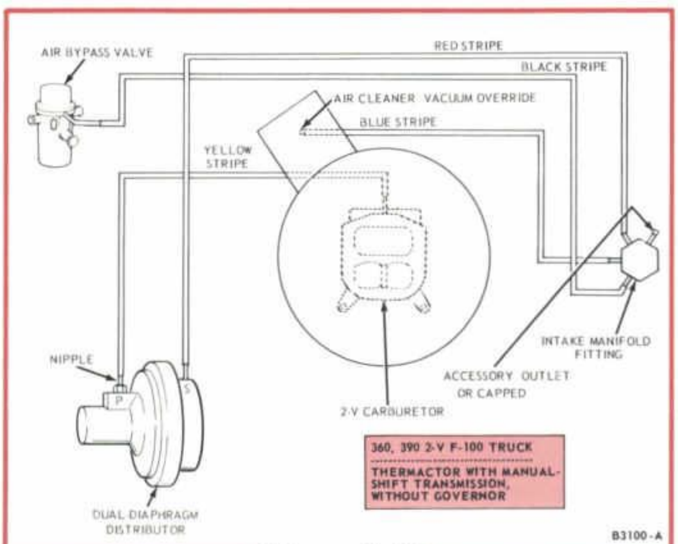

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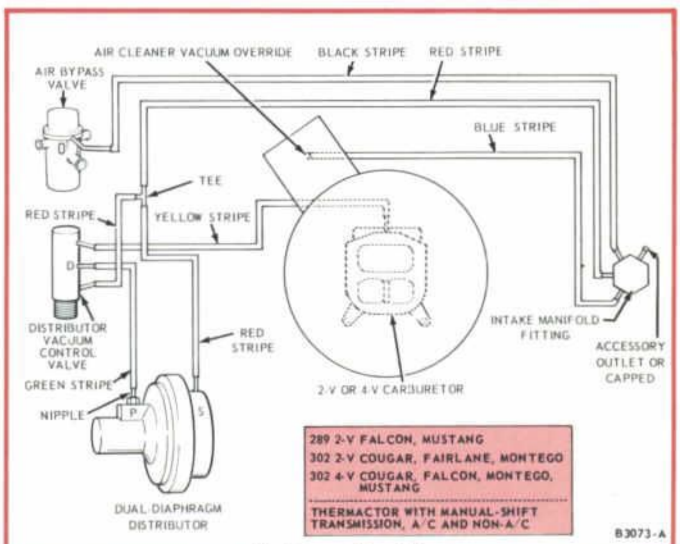
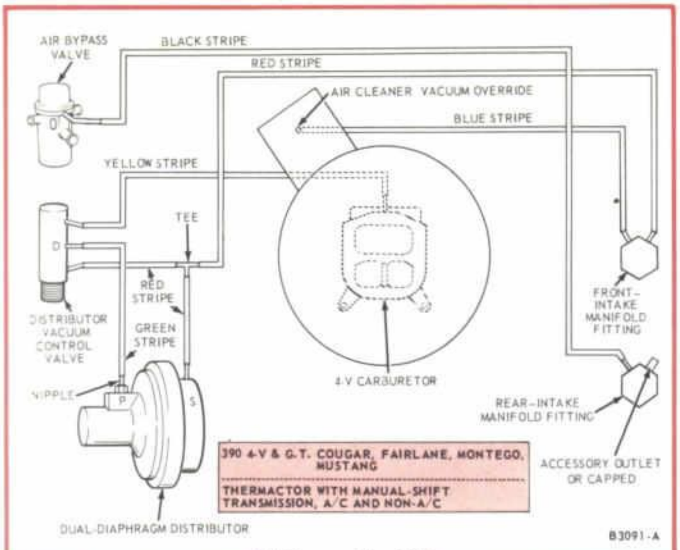


Schematic 24

DISTRIBUTOR VACUUM SYSTEM SCHEMATICS



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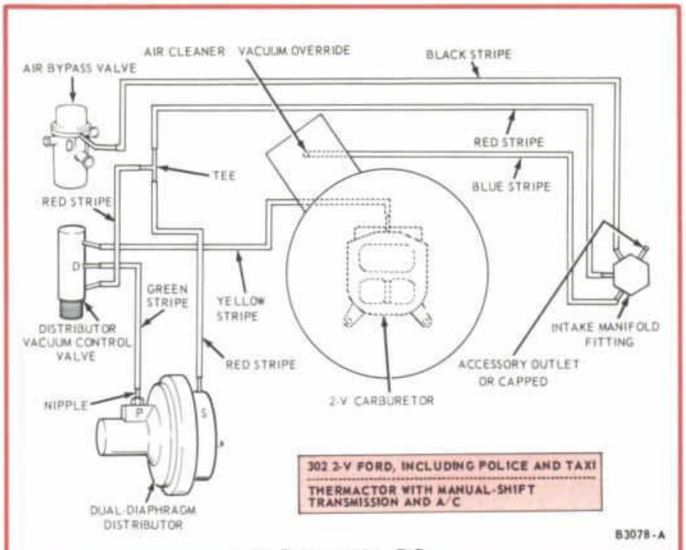
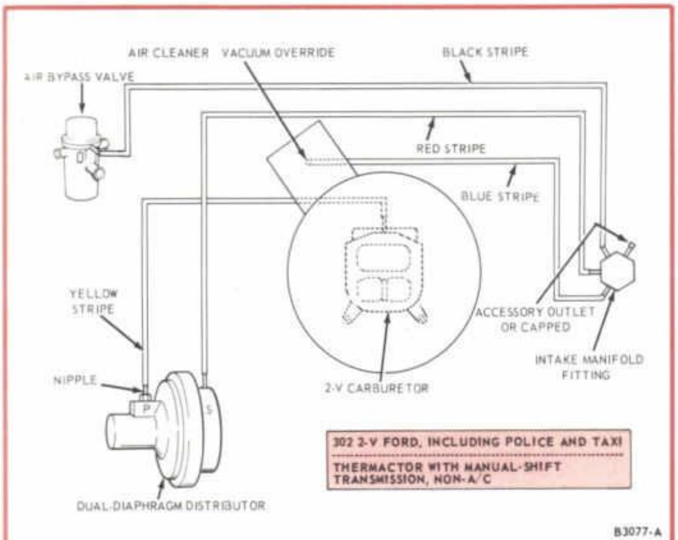


Schematic 26



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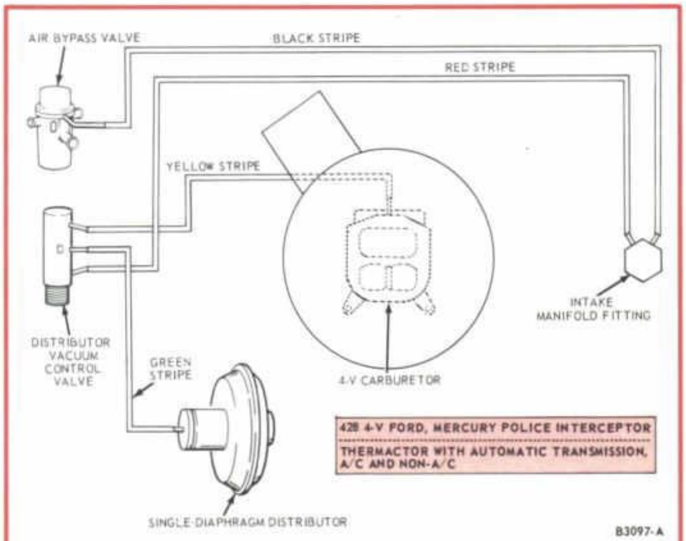

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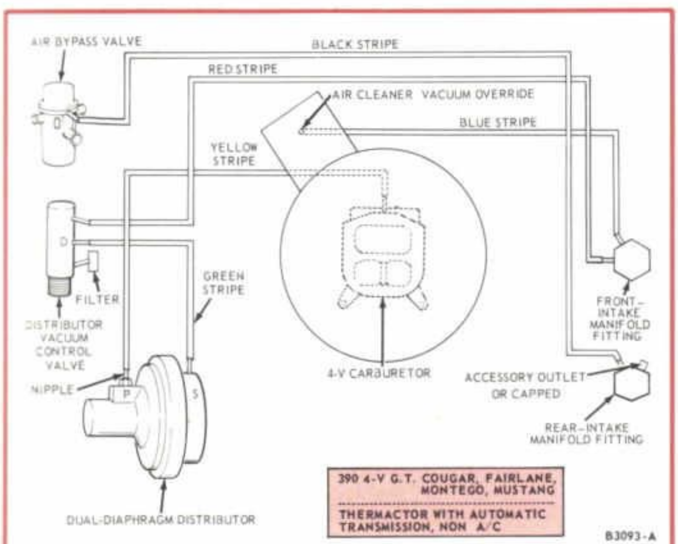

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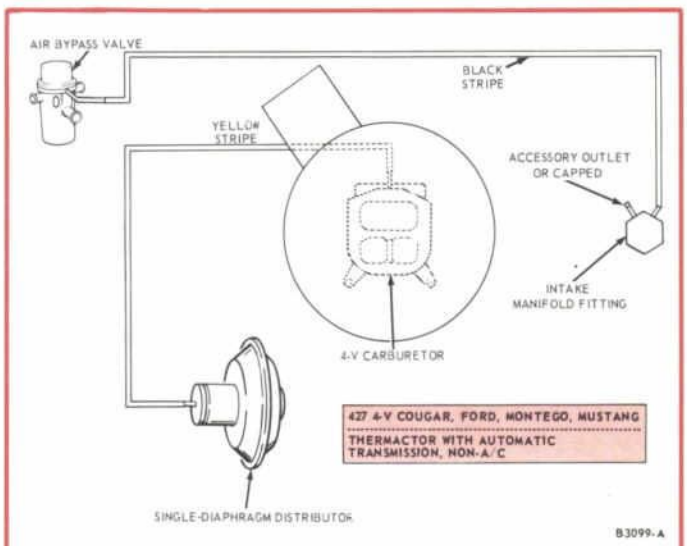

Schematic 30

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